The Pennsylvania State University

The Graduate School

College of Education

EXPLORING THE BELIEFS AND ATTITUDES OF EXEMPLARY TECHNOLOGY-USING TEACHERS

A Thesis in

Instructional Systems

by

Paula Mae Bigatel

© 2004 Paula Mae Bigatel

Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Doctor of Philosophy

May 2004

The thesis of Paula Mae Bigatel was reviewed and approved* by the following:

Barbara L. Grabowski
Associate Professor of Education
Thesis Advisor
Chair of Committee

Jill L. Lane
Affiliate Assistant Professor of Education

J. Daniel Marshall
Professor of Education

Kyle L. Peck
Professor of Education
Head of the Department of Learning Performance Systems

*Signatures are on file in the Graduate School

ABSTRACT

The purpose of this study was to describe exemplary technology-using teachers' beliefs and attitudes about teaching, learning, and technology use in education while uncovering the process of how these beliefs and attitudes are formed and are influenced by many contextual factors in the school culture. Finally, this study described how the exemplary technology-using teachers' beliefs and attitudes influenced their classroom practices with technology. In this study, exemplary technology-using teachers are defined as those who effectively integrate technology into their instructional practices in K-12 educational contexts. Furthermore, this study theorized about the contextual factors that influenced the development and sustainability of teachers' beliefs and attitudes. To date, little known research has focused on the process of how beliefs and attitudes are acquired and how they may influence technology use in the classroom as well as how they are influenced by the learning context. Moreover, no grounded theory methodological approach had previously been employed in a study of exemplary technology-using teachers' beliefs and attitudes related to instructional practices. The findings of this research have implications for professional development that would take into consideration a complex array of contextual variables that interact systemically. The insights gained from this study could be used to design teacher training (in-service and preservice) that helps foster technology use in effective and meaningful ways that could enhance student learning.

This study used a constructivist grounded theory approach (Charmaz, 2000) in order to develop an emerging theory from the data collected in partnership with the

teacher participants. The study used multiple sources of data, including interviews, documents, physical artifacts, electronic data, memos (field notes), and direct classroom observations to achieve a triangulation of data (Lincoln & Guba, 1985). The findings of this study suggested that the teachers' beliefs and attitudes are consistent with their instructional practices and that supportive and resource-rich learning environments are important factors in the teachers' development and sustainability of effective technology integration practices. Another important finding suggested that that these exemplary technology-using teachers exhibited similar personal characteristics that are expressed in their learner-centered practices. There seems to be a strong connection between their exemplary technology use and their learner-centered beliefs, as well as between their attitudes and practices in learning contexts that value learner-centered beliefs and attitudes. Although the working hypotheses of this study mainly apply to the four school districts investigated, the insights gained from the study of exemplary technology-using teachers at these research sites may prove valuable in other contexts.

TABLE OF CONTENTS

LIST OF FIGURES ix

LIST OF TABLES x

CHAPTER 1. Introduction 1

Purpose of the Study 4

Research Questions 5

Theoretical Framework 6

Significance of the Study 8

Definitions of Key Terms 10

Summary 12

CHAPTER 2. Literature Review 14

Teachers' Self-Beliefs (Efficacy) and Attitudes toward Technology Use 20

The Influence of Contextual Factors on Beliefs and Attitudes 24

The Value of Technology: The Impact on Learning 25

Student Variables 30

Content Variables 32

Teacher Variables 33

Instructional Contexts 35

Contextualized Research 39

Summary 40

CHAPTER 3. Research Methods 43

Sampling Procedures 43

Selection of the Sites 43

Selection of the Teachers 45

Qualitative Research Design 46

Rationale for Using a Grounded Theory Approach 48

Theoretical Perspective and Grounded Theory Procedures 49

Justification for Selecting Qualitative Methods 52

Constant Comparison Method 53
Ethical Issues 54
My Role as the Researcher 56
Data Collection Strategies 57
Data Management and Analysis 66
Quality of Research 67
Limitations of the Study 69
Summary 71

CHAPTER 4. Data Analysis and Findings 72
The Data Analysis Framework 72
The Pedagogical Domain 74
Definitions of Beliefs and Attitudes 74
Self-Beliefs 76
Caring and Compassion 77
Respect for Students 80
Comfort and Confidence 83
Openness to Change 85
Summary of Self-Beliefs 88
Beliefs About Learning 89
Diverse Student Learning Styles 90
Active Learning 92
Teacher as Facilitator 95
Student Interests Taken Into Account 97
Collaborative Learning 99
Summary of Beliefs about Learning 102
Cultural/Environmental Domain 103
Early Learning Environments 103
Summary of Early Learning Environments 108
Supportive and Resource-Rich Learning Environments 109
Summary of Supportive and Resource-Rich Learning Environment 116

The Pedagogical Domain 116
Pedagogical Expertise 117
Sound Pedagogy Drives Technology Use 123
Summary of Pedagogical Expertise 128
Summary 128

CHAPTER 5. Discussion and Recommendations 131
Introduction 131
Discussion of Results 131
Towards an Emerging Theory of Exemplary Technology Using Teachers 141
Interaction of Personal, Contextual, & Pedagogical Factors 142
Implications for Further Research 149
Implications for Practice 153
Conclusion 156

REFERENCES 158

APPENDIX A: Sample Email to District Superintendent 169
APPENDIX B: Sample Email to Principal/Technology Coordinator 170
APPENDIX C: Sample Email to Exemplary Technology-Using Teacher 171
APPENDIX D: Teachers' Demographic Variables 173
APPENDIX E: Interview Protocol 174
APPENDIX F: Informed Consent Form 175
APPENDIX G: Classroom Observation Protocol 177
APPENDIX H: Classroom Variables of Engaged Learning 178
APPENDIX I: Indicators of Engaged Learning 179
APPENDIX J: National Educational Technology Standards for Teachers 181
APPENDIX K: Document Analysis Protocol 182
APPENDIX L: Learner-Centered Psychological Principles 183

LIST OF FIGURES

Figure 1.1	Process of Beliefs and Attitudes Formation	...5
Figure 1.2	Theoretical Framework	...8
Figure 2.1	Interaction of Beliefs, Attitudes, and Instructional Practices	...25
Figure 2.2	Contextual Variables in Teaching and Learning with Technology	...28
Figure 4.1	Data Analysis Framework	...73

LIST OF TABLES

Table 3.1	Technology Resources Observed in the Classrooms	47
Table 3.2	Data Sources Related to the Research Questions	50
Table 3.3	Research Design Phases	54
Table 3.4	Summary of the Data Collected	67
Table 3.5	District Data Collected	68
Table 3.6	Teachers' Demographic Variables	69
Table 4.1	Teachers' Definitions of Beliefs	75
Table 4.2	Teachers' Definitions of Attitudes	75
Table 4.3	Teachers' Caring and Compassion	77
Table 4.4	Districts' Caring and Compassion	79
Table 4.5	Teachers' Respect for Students	80
Table 4.6	Districts' Respect for Students	82
Table 4.7	Teachers' Openness to Change	86
Table 4.8	Teachers' Attitudes towards Change	87
Table 4.9	Teachers' Beliefs about Diverse Learning Styles	91
Table 4.10	District Belief and Goal Statements on Diverse Learning Styles	92
Table 4.11	Teachers' Beliefs about Active Learning	93
Table 4.12	Teachers' Definitions of Learning	94
Table 4.13	Teachers' Beliefs about Facilitator Role in Learning	96
Table 4.14	Early Learning Environments	104
Table 4.15	Positive Learning Environments	106
Table 4.16	Positive Teacher Role Models	107
Table 4.17	Teacher Education Experiences	108
Table 4.18	District Mission and Belief Statements	111
Table 4.19	Supportive Learning Environments	113
Table 4.20	Learner-Centered District Beliefs	115
Table 4.21	Instructional Strategies With or Without Technology	126

CHAPTER 1

Introduction

Researchers have illustrated how computer technologies can be powerful tools that can greatly impact how and what students learn (David, 1994; Dwyer et al., 1991; Dwyer, 1994; Milken Exchange, 1999). Despite the increasing availability of computers in schools, researchers and educators still report that integrating technology into classroom practices is not easily accomplished (Cuban, 2001; Ertmer, 1999; Ertmer et al., 1999; Hadley & Sheingold, 1993; Jones, 2001; Schrum, 1999). Emphasis has been placed on training teachers to use computer hardware and software but not on how to integrate these tools into effective instructional practices (OTA, 1995; Pedersen, 2003; Schmidt et al., 2002). Researchers have identified many factors that influence the successful integration of technology into the curriculum, including teachers' preferred instructional methods and their corresponding beliefs about teaching and learning (Becker, 2001; Hannafin & Savenye, 1993; Niederhauser & Stoddart, 2001; Pierson, 2001; OTA, 1995). Ravitz, Becker, and Wong (2000) investigated constructivist-compatible beliefs and practices among U.S. teachers in a 1998 national survey and reported that teachers' beliefs about teaching and learning are closely related to their instructional practices. Findings from the survey indicated that teachers holding constructivist philosophies about teaching and learning reflected more constructivist practices, and constructivist-oriented teachers used computers professionally in more varied ways, had greater technical expertise in the use of computers, and used computers frequently with students in

seemingly more powerful ways. Constructivist pedagogies and technical skill with computers have been closely connected in studies conducted by Becker (2000), Dwyer, Ringstaff, and Sandholtz (1991), and Sandholtz, Ringstaff, and Dwyer (1997). Since constructivist beliefs and practices seem to facilitate effective uses of technology, researchers have used this premise to successfully change teachers' epistemological beliefs by training them to use computer-based educational tools and to explore constructivist instructional approaches (Howard et al., 2000; Vannatta & Beyerbach, 2000; Windschitl & Sahl, 2002). Nespor (1987) argued that teachers' beliefs play a major role in defining how they approach their teaching tasks. Cuban (1993) suggested that teachers' knowledge, beliefs, and attitudes shape what they choose to do in their classrooms and inform their instructional practices.

Consequently, it is important to examine teachers' belief systems and institutionalized instructional routines that support or impede their technology use in order to overcome barriers to their successful technology integration. While technology is prevalent in our schools, the pressing issue currently centers on <u>how</u> technology is or is not being used in the teaching and learning process, as student achievement may be compromised by poor technology integration practices.

There is little doubt that technology plays an important role in our schools, considering the wide range of computer applications in today's world. Consequently, teachers must be prepared to use computers in their instructional practices and to do so in pedagogically effective ways. Research has shown that many elementary teachers still feel uncomfortable using computers (Guha, 2000; Marcinkiewicz, 1993; McDermott & Murray, 2000; Rosen & Weil, 1995; Ross et al., 1999; Scheffler & Logan, 1999). Among

teachers, Schechter (2001) found a strong predictive relationship between higher levels of technology use and comfort, confidence and proficiency (attitude variables) with using computers. In addition to these variables, teacher attitudes about the value of technology use in education have been shown to affect their levels of technology implementation. For example, studies have shown that teachers' beliefs and attitudes regarding the advantages of teaching with technology are significantly correlated with higher levels of technology implementation (Becker, 1994; Lebrutto, 2001).

Currently, teachers' access to technology itself is becoming less of a concern than what they do with it (Becker, 1999; *Education Week*, 2001; Milken Exchange, 1999; OTA, 1995). However, more effective teacher training (in-service and pre-service) in technology is becoming more of a need, which should consider the powerful influencing factors of teachers' beliefs and attitudes related to technology. Yet, it may be more important to look at how teachers are learning to implement computers in the classroom, how their instructional practices reflect their beliefs about the teaching/learning process, and how they feel about the value of technology in education, because the teacher is key in the eventual success or lack of success of any computer-in-education initiative (Collis, 1996). Professional training must focus on providing not only technical and pedagogical skills, but also on habits of mind that encourage successful technology integration. If we understood more about how and why beliefs and attitudes are formed, for example, by exemplary technology-using teachers, we might understand better how to foster or change beliefs and attitudes about teaching and learning with technology and the value of technology in classroom instruction, which may ultimately lead to better classroom practices that integrate technology more effectively.

Purpose of the Study

The purpose of this study was to describe exemplary technology-using teachers' beliefs and attitudes about teaching, learning, and technology use in education while uncovering the process of how these beliefs and attitudes are formed and are influenced by many contextual factors in the school culture. Finally, this study described how the exemplary technology-using teachers' beliefs and attitudes influenced their classroom practices with technology. By investigating exemplary technology-using teachers, we might gain insight not only into their beliefs and attitudes about teaching, learning, and technology but also into which particular factors (past and present) may have influenced the development of those beliefs and attitudes (e.g., the effect of context). If we understand why and how teachers acquire and hold beliefs and attitudes, we may be better able to help other teachers change their beliefs and attitudes to positively impact their instructional practices and student learning/achievement. To date, there has been little in-depth research on the process of how teacher beliefs and attitudes are acquired and how they may influence technology use as well as be influenced by the learning context. Much survey research exists, but little qualitative research using a grounded theory approach has been done on exemplary technology-using teacher beliefs and attitudes. This study fills a gap in the research literature on exemplary technology-using teacher beliefs and attitudes in that it examines exemplary technology-using teachers by employing a particular type of qualitative methodology i.e., a constructivist grounded theory approach. No known research to date has approached the topic in this manner.

Practical implications of the results of this study may provide valuable insight to be considered when designing teacher training (in-service and pre-service) and sustaining technology use in meaningful ways that enhance the teaching and learning process. Figure 1.1 illustrates some potential variables involved in the process of acquiring beliefs and attitudes that may affect instructional practices.

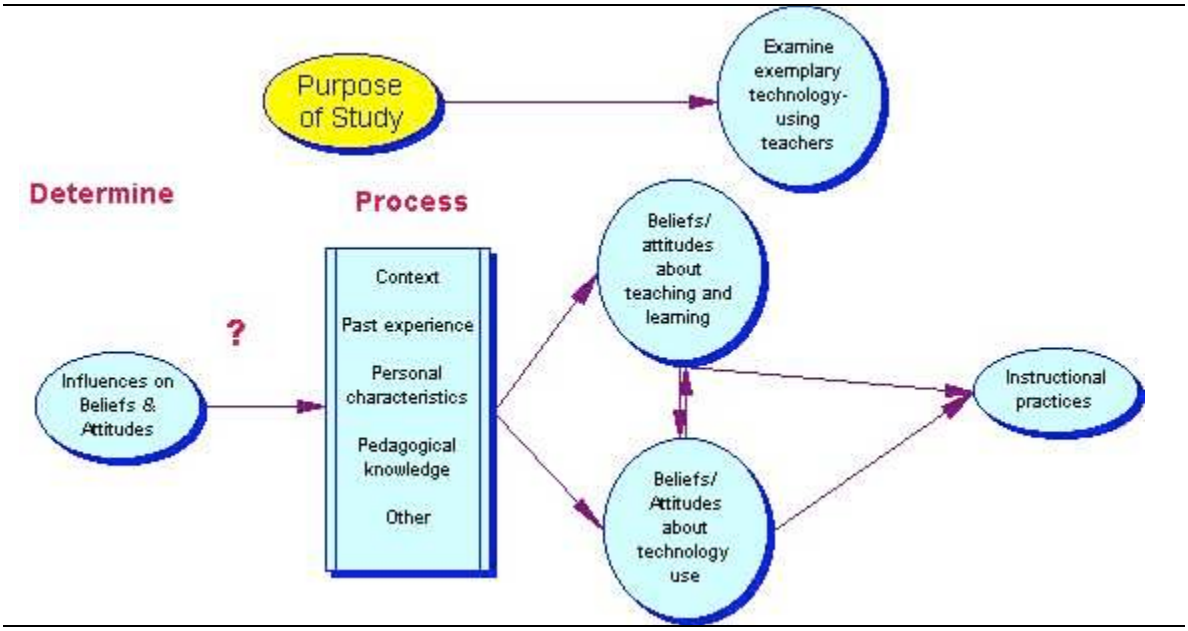

Figure 1.1. Process of beliefs and attitudes formation

Research Questions

This study addressed the following three research questions:

1. What are the beliefs and attitudes of exemplary technology-using teachers with respect to (a) the teaching and learning process and (b) the value of using technology in education?

2. What has influenced the development of the beliefs and attitudes of exemplary technology-using teachers?

3. How have exemplary technology-using teachers' beliefs and attitudes affected their instructional practices?

Theoretical Framework

The theoretical framework for this study is grounded in psychological bases for the adoption of different teaching practices. Bandura's Social-Cognitive Learning Theory (1971) implies that behavior, cognitive, and other personal factors, as well as environmental influences, all operate interactively as determinants of each other. According to Bandura, an individual is continuously participating in an ongoing reciprocal interaction process, acting on the basis of his/her own reasons, beliefs, expectations, needs, and motives, etc. Individuals' expectations, beliefs, goals, and intentions shape their behavior. Instructional decisions such as selection of materials and choice of instructional practices would thus be made on the basis of beliefs or goals that guide these decisions (Bandura, 1997).

In addition, Bandura's construct of self-efficacy is a useful one in educational research and can be applied to the likelihood of a teacher's use of technology based on one's beliefs about one's capabilities to learn and use technology effectively. Furthermore, Bandura's concept of modeling and observation in learning new skills is useful with respect to providing reinforcement strategies targeted to help teachers develop their own effective practices. Other concepts from social learning theory that have relevance to the purpose of this study are derived from Vygotsky (1986), who emphasized the importance of environmental and cultural influences on behavior. The

role of context is important in learning and changing beliefs and practices, so therefore, their impact should not be ignored.

Jerome Bruner's cognitive-interactionist theory also recognizes the impact of culture and its role in how one constructs reality from which one exercises situational choice (Bigge & Shermis, 1992). In cognitive interactionism, an individual is considered to be an interactive, intentional subject, continuously participating in an ongoing reciprocal situation-interaction process. In this process, one acts on the basis of one's beliefs, expectations, needs, and motives, which have been influenced by one's interactions with the social environment. Therefore, decisions about practices reflect the interaction between one's personal perspectives (conditioned by cultural environment past and present) and one's contextual situation.

The purpose of this study was examined from these theoretical perspectives. The effectiveness of technology integration is dependent on educational leaders' understanding that the beliefs teachers hold about learning form a framework for how and why they adopt new content, programs, and ways of teaching (Cuban, 1993; Fullan, 2001). As Cuban has suggested, "The knowledge, beliefs, and attitudes that teachers have shape what they choose to do in their classrooms and explain the core of instructional practices that have endured over time" (p. 256). This study was designed to examine the interacting factors of teachers' beliefs about teaching and learning, how these beliefs are shaped and, in turn, shape/influence technology-integration practices in the context of actual classroom activities. Figure 1.2 presents a theoretical framework of interacting factors.

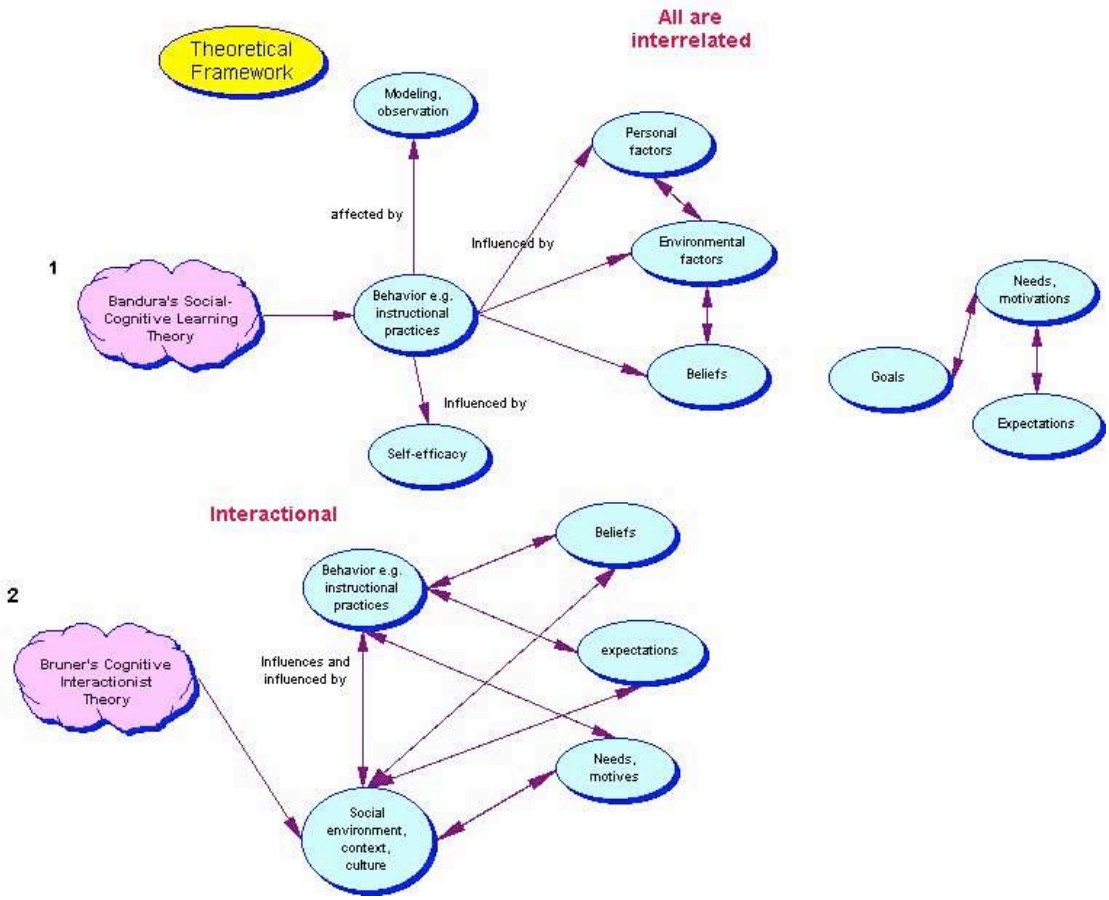

Figure 1.2. Theoretical framework

Significance of the Study

Beliefs and attitudes are not only reflected in teachers' decisions and actions but are also evidenced by the important pedagogical decisions they make in their classroom practices (Renzagalia & Hutchins, 1997). A growing body of educational research is

shifting from instructional strategies and teaching behaviors to the beliefs and perspectives that prompt teachers to use these instructional strategies (Albion & Ertmer, 2002; Hashweh, 1996; Powell, 1996; Richardson, 1996; Stuart & Thurlow, 2000). Can we learn from exemplary technology-using teachers about effective technology-integration strategies and the attendant beliefs and attitudes that have had an impact on their instructional practices? Can we learn from the process of how these exemplary teachers acquired their beliefs and attitudes about teaching and learning and the value of technology in education? It has been suggested that a change in belief follows rather than precedes a change in behavior (Guskey, 1986; Howard et al., 2000). If teacher education (in-service and pre-service) focuses on the models of exemplary technology-integration practices and the underlying beliefs and attitudes that support them, teachers may be helped to reflect on the connections between theory and practice. If teachers do not bring beliefs and attitudes to a conscious level and articulate and examine them, they might perpetuate current practices or the status quo (i.e., teach how they were taught).

This research study brings together issues of teachers' beliefs and attitudes about teaching and learning and how these beliefs and attitudes shape their uses of technology in their instructional practices. Moreover, this study attempts to delineate the process by which exemplary technology-using teachers have developed their beliefs and attitudes about teaching and learning.

An important aspect of this study is the importance of teachers' voices and their interpretations of their own experiences. The process of interpretation should uncover interactions of many mutually shaping factors that affect beliefs, attitudes, and classroom practices, revealing that a complex relationship exists between beliefs and practice;

beliefs influence practice and practice influences beliefs. Currently, however, there is a gap in the literature whereby researchers have not examined the beliefs, attitudes, and instructional practices of exemplary technology-using teachers with a constructivist, grounded theory approach. A review of the literature has revealed that much of the research on the beliefs and attitudes of technology-using teachers has used a survey or quantitative methodology. Furthermore, to date, no known grounded theory study has been done to examine the process of how beliefs and attitudes of exemplary technology-using teachers are shaped.

Definitions of Key Terms

Beliefs: Beliefs are "psychologically held understandings, premises or propositions about the world that are felt to be true" (Richardson, 1996, p. 103). Beliefs are mainly cognitive and are typically expressed with the phrase "I believe." In this study, teachers may have their own definitions of beliefs, which will be incorporated, acknowledging that there may be a wide diversity of understandings of the construct.

Attitudes: Attitudes are affective in nature. Allport (1967) defined attitudes as " a mental and neural state of readiness, organized through experience, exerting . . . influence upon the individual's response to all objects and situations with which it is related"(p. 8). Attitudes are typically expressed with the phrase "I feel that . . . ." In this study, the teachers' definitions of attitudes were incorporated.

Constructivism: Learners are active constructors of their knowledge and their reality. Constructivists believe that the learners are primarily responsible for their own learning and formation of knowledge. In this paradigm, knowledge is not transmitted from teacher to student as if students are passive receptacles of this knowledge.

Technology: In this study, technology refers primarily to computers, computer peripherals, and computer-related technologies such as data communications, interactive video, and digital television. Technology is viewed as a tool to support student inquiry, production, collaboration, and communication (Means, 1994, p. 9).

Learner-Centered Instruction: Learner-centered environments focus on learners' needs. Learners are active participants in the learning process guided by teachers who facilitate students in meaningful inquiries where discovering relationships among facts is valued over memorizing facts (Sandholtz, Ringstaff, & Dwyer, 1997, p. 183). Learner-centered instruction incorporates much less of the traditional transmission model of teaching. Instead, knowledge-building and collaborative activities are balanced with the sensible use of guided practice and direct instruction.

Technology Integration: In this study, the use of technology is regarded as a powerful tool for teaching and learning. Technology is employed seamlessly in learning activities to meet curricular goals. Curriculum drives the use of technology and is incorporated in the teaching and learning process so that students are exposed to a variety of technology

tools, ranging from high tech to low tech. Technology is not an add-on to the curriculum nor is it treated as a separate content area (Sandholtz, Ringstaff, & Dwyer, 1997).

Learning: In this study, learning does not mean how well students perform on standardized tests. Rather, the definition of learning is taken from the work of Barbara Means of SRI International (Means, 2003), which has been expanded by Jones et al. (1995) in their framework for engaged learning. Engaged learning involves more student interaction, more connections among schools, more collaboration among teachers and students, more involvement of teachers as facilitators, and more emphasis on technology as a tool for learning. Student achievement is gauged not only by how well students achieve on standardized tests but also, and more importantly, by students' ability to use higher-order thinking skills.

Value of Technology: The term 'value of technology', as it is used in this study, refers to the embracing of technology as a tool to enhance student learning.

Summary

This study examined the beliefs and attitudes of exemplary technology-using teachers and asked: what are these beliefs and attitudes about teaching and learning and the value of technology in education? The study investigated the process of how these teachers' beliefs and attitudes had been and currently are being shaped by contextual variables that influence instructional practices. It was hoped that in answering these

questions, light has been shed on which beliefs and attitudes support effective technology-integration practices, and which contextual factors have an important impact on the encouragement and sustainability of effective technology-integration practices. The answers to these questions could benefit designers of professional development for pre-service and in-service teachers, because they could apply the lessons learned from these teachers and their respective contexts. School leaders concerned about reform efforts could benefit because the better trained the teachers are, the more students benefit.

CHAPTER 2

Literature Review

Any innovation, whether in education or in the workplace, creates some personal dissonance. It is important to examine how teachers' beliefs support or inhibit an innovation (i.e., technology integration) before expecting acceptance and change to occur. Personal belief systems exert a powerful influence on teachers' decision making and on the instructional practices they use in their classrooms (Niederhauser, & Stoddart, 2001; Pajares, 1992). Instructional changes involving innovations, like the use of computers, will be filtered through teachers' structure of knowledge and beliefs about teaching and learning. Ertmer (1999) describes teachers' belief systems in terms of what she calls second-order barriers that interfere with change in teaching practices. She states that teachers may not be aware of their own underlying beliefs about teaching and learning. Thus, it is important to bring about an awareness of what these beliefs are and the underlying values and assumptions that are the foundations of these beliefs because awareness may one way to effect change in instructional practices especially if teachers unquestioningly teach as they were taught. As Nespor (1987) emphasized, teachers' ways of thinking and understanding form important components of their practice.

Teachers' beliefs are conditioned by how they were taught, and early in the education process, teachers have formed a philosophy of teaching and learning that becomes quite ingrained and resistant to change (Dwyer et al., 1991; Kagan, 1992; McKinney et al., 1999; Norum et al., 1999). Teachers must question these beliefs as they attempt to change teaching practices. For example, technology integration precipitates

changes in the learning environment, which affects teachers' and students' roles in the classroom. It might take some adjusting to the idea that teachers can learn from students who may know more about technology than they do. This new learning environment may cause teachers to have a sense of loss of control because the one-way knowledge transmission model (teacher passing knowledge to student) may be incompatible with allowing students to be peer teachers who serve as additional resources in the classroom (Ertmer, 1999). Teachers must be ready to re-examine their teacher roles. Resistance to this new "peer" role may clearly be connected to teachers' preference for and adherence to old patterns of instructional methods (Hannafin & Savenye, 1993; Johnson, 1997), and their belief that responsibility for learning rests solely with them. If teachers believe that they are to be in charge at all times and the sole dispensers of knowledge, then relinquishing that role will require some shifts in their deeply held beliefs and ingrained habits of practice.

Additionally, Niederhauser and Stoddart (2001) found that teachers who hold more traditional beliefs about teaching and learning tend to use more didactic instructional methods (i.e., lecturing) and more teacher-centered practices, while teachers who hold more constructivist beliefs about learning tend to use more student-centered, inquiry based methods. Powell (1996) investigated how teachers' prior experiences, beliefs about knowledge, and schooling context collectively influences their ability to implement curricula with a constructivist orientation. The findings of Powell reinforced the connection between constructivist practices and student-centeredness.

Teachers' beliefs about how learners learn are typically expressed in their instructional practices. Ravitz and Snow (1998) provided evidence that teachers who held

constructivist beliefs expressed them in constructivist practices such as project-based and problem-solving activities, group work that encourages sense-making and critical thinking on the part of students. Furthermore, these constructivist-learning contexts foster cognitive challenge (e.g., reflective writing, probing questions, etc.). Stuart and Thurlow (2000) studied the impact of pre-service teachers' beliefs and attitudes and on their classroom practices. They found that pre-service teachers who were challenged to reflect on their beliefs, and how those beliefs were heavily influenced by how they were taught, could gain more insight into their decision making about instructional practices. They would be more apt to break the cycle of teaching how they were taught and try new approaches (i.e., constructivist). Ultimately, such change could not have occurred if they had not reflected on their present and past practices.

Moreover, many researchers have made an important connection between constructivist beliefs and practices and effective technology within the last decade. A national survey conducted in the spring of 1998 (*Teaching, Learning, and Computing: 1998 National Survey*, OERI) focused partially on the relationship between teachers' pedagogy and their use of computers in teaching (Becker, 2000; Ravitz, Wong, & Becker, 1999; Riel & Becker, 2000). These researchers found that constructivist-oriented teachers have greater technical expertise, use computers more frequently with students, and use them in more powerful ways. Their evidence comes from a national survey of Teaching, Learning, and Computing (TLC) (Ravitz, Becker, & Wong (2000), where those teachers higher in constructivist philosophies reported that their students used computers more often, and for challenging tasks that targeted higher order thinking skills (e.g., problem-solving). For example, students would be involved in projects that

extended a week or more, and the tasks required within the context of the project were cognitively challenging covering more than one discipline. Berg et al. (1998) found that exemplary technology-using teachers were more student-centered and exemplified more constructivist beliefs. These teachers valued collaboration, integration of subject areas through project-based activities, and interactivity among students. Students were found to use technology predominantly as a tool in a constructivist mode. Vannatta and Beyerbach (2000) described a Goals 2000 pre-service technology infusion project that facilitated integrating technology with constructivist practices (i.e., project-based activities). Findings from this project indicate that technology could be used as a powerful instructional tool to engage learners in meaningful learning. In a study conducted by Howard, McGee, Schwartz, and Purcell (2000), teachers learned about constructivism by using it in the context of being trained to use computer-based educational tools. The results indicated that the teachers were able to change their epistemological beliefs (favoring constructivism) within an intensive four-week training period, using constructivist strategies that complemented technology use.

Honey and Moeller (1990) found that there were certain discernible patterns between teachers' pedagogical beliefs, their instructional practices, and the integration of technology into their classroom practices. High-tech teachers employed more progressive educational practices, such as the use of inquiry and discovery skills, project-oriented work, group-based activities, and hands-on activities. Dirksen and Tharp (2000) evaluated a Goals 2000 project carried out in a rural Western school district where participants were being trained to develop skills with a variety of software applications and the integration of technology within the curriculum. They observed that teachers who

had their students create presentation products using the Internet as a research tool viewed computers as a generative learning tool to be used to help students develop higher-order thinking skills. These teachers were more skilled in using the Internet and presentation software, from which the researchers concluded that the students benefited. Those teachers who used computers as a word-processing tool primarily had students type their final products such as reports, stories, and poems. With teachers who had less computer skill and knowledge of a variety of software applications, students were using the computer as a workbook and using drill and practice computer programs designed to reinforce knowledge and skills introduced by these teachers.

In technology-rich environments, the process of learning is transformed to permit more student participation and a focus on students' individual learning styles, according to a study done by McDermott and Murray (2000), which was conducted in a K-2 building in a Midwest middle-class suburban city. These authors felt that the teachers' philosophies about how learners learn must be re-evaluated in order to embrace the idea that learners are constructors of knowledge and meaning. In a technology-rich environment, the role of teacher must shift to focus more on the student's active role in learning. For example, the Apple Classroom of Tomorrow (ACOT) project exemplified how teachers' beliefs and practices changed as teachers realized the benefits of the role shifts not only with students but also with other teachers with whom they collaborated. The teachers in this project were given access to multiple computers in their classrooms and laptops for personal use. Technology was infused into their teaching and learning environment. Teachers in the ACOT project helped one another across content areas and team taught in the context of project-based instruction (Dwyer et al., 1991; Dwyer, 1994).

The outcome of this project seems to hold some promise for changing teachers' beliefs that, in turn, might result in a change in teaching practices to include higher levels of technology integration.

Niederhauser and Stoddart (2001) examined the relationship between teachers' instructional perspectives and beliefs about learning and their corresponding use of educational software. They classified instructional software into two categories based on the design and purpose of the software: skills-based software, which embodied a traditional transmission approach to instruction, and open-ended software, which embodied a constructivist, learner-centered approach. The authors found a consistent relationship between teachers' perspectives about the instructional uses of computers and types of software they used with their students. Teachers who used only open-ended software had a strong learner-centered orientation and weak computer-directed orientation, while teachers who used only skill-based software had the strongest computer-directed and lowest learner-centered orientations. When the authors looked at K-2 teachers and compared them to grades 3-6 teachers, the results indicated that K-2 teachers favored the use of skill-based software over open-ended software to a greater degree than the 3-6 grade teachers. The authors pointed out that this could be due to the fact that teachers at the primary grade levels need to emphasize foundational skills in the early grades and that there is wide availability of skill-based software designed for young children.

Teachers' Self-Beliefs (Efficacy) and Attitudes toward Technology Use

Teachers' beliefs in their ability to positively affect student learning have an impact on their willingness to embrace innovative teaching approaches according to McKinney et al. (1999). Teachers must believe that an innovation will enhance student learning before they will be receptive to change, and there is evidence that most teachers do see the advantages of technology integration into the curriculum in terms of enhanced student learning and increased motivation (Ertmer, 1999; Ertmer et al., 1999). However, teachers have to believe that they are capable of teaching effectively with technology. Honey and Moeller (1990), using qualitative research methods (e.g., interviews & observations), have shown that teachers who successfully integrated computers into their teaching regarded themselves as learners along with their students, and were highly motivated because they expended their own time and effort in learning to use computers. These teachers exhibited confidence in their ability to learn new technology skills. Similar findings were noted in studies conducted by Sheingold and Hadley (1990), Marcinkiewicz (1994), Lumpe and Chambers (2001), and Beaudin (1999). Lumpe and Chambers found that self-efficacy beliefs (confidence) were a significant predictor of teachers' self-reported use of technology-related engaged learning practices. Similarly, Schechter (2000) found a significant correlation between a teacher's comfort and proficiency with using computers and the degree to which he/she employed computers as a process, product, and tool to solve authentic curriculum-related problems. In summary, teachers with higher levels of comfort and proficiency tended to implement technology at

higher levels of integration. Lack of confidence and/or comfort can be powerful de-motivators in regard to technology implementation and integration.

Teachers' beliefs about the efficacy of the role of technology in education also may have an influence on how computers are used in the classroom. Becker (1994) differentiated exemplary computer-using teachers from other teachers and found that the exemplary teachers used technology differently and that their goals for computer use were different. Students used computers in "consequential" activities such as creating newsletters, producing a school newspaper, or writing for the school yearbook (i.e., authentic tasks). There was a greater use of software for higher order thinking activities such as interpreting data, reasoning, writing, solving real-world problems, and conducting scientific investigations. Less time was spent on recreational activities such as game playing.

In a study conducted by Ertmer et al. (1999), there appeared to be a connection between teachers' uses of technology and their beliefs about the role of technology. How teachers used technology was related to the role they believed technology should play in the curriculum. When they interviewed teachers, they found that those who did not value technology as a tool for enhancing learning used the computer as an optional activity. Students were permitted to use computers as a reward after completing "regular" classroom work. These teachers did not see the relevancy of computer use as integral to the curriculum. They felt that once they had taught the students new skills, they could use the computers for drill and practice work to reinforce what they had already learned. In their study, however, one teacher did change her beliefs about using computers in a way

that “drove” her curriculum. She began using computers not only as a support to what she taught but as an integral part of her teaching.

Clearly, changing beliefs takes time, and as some researchers have found, it seems to follow a developmental pattern (Dwyer et al., 1991; Johnson, 1997; McKinney, 1999; Mills, 1999; Pajares, 1992). Pajares views conceptual and belief change in terms of Piaget’s processes of assimilation and accommodation. Assimilation is the process whereby new information is incorporated into existing beliefs, and accommodation takes place when new information cannot be assimilated and existing beliefs must be replaced or reorganized. McKinney et al. (1999) assert that the change process occurs in a sequential manner. They noted three stages of innovation: initiation, implementation, and refinement. Their theoretical model suggests that participants involved in an innovation will move through these stages, expressing different sets of concerns. The stages of concern coincide with the stages of innovation, beginning with little concern or involvement with the innovation at the outset. However, with more involvement, an individual’s concern seems to be centered on the desire to know more about the innovation, along with the availability of training or support for the innovation. This, in turn, leads to concern about practices involved with implementation; then, finally, to refinement that involves finding better ways to incorporate the innovation. Throughout these stages, self-efficacy is affected. In the beginning of an innovation, certain sets of concerns tend to be expressed by participants with lower efficacy beliefs, while those with higher efficacy have concerns characteristic of the later stages of change, that is, the impact of the change. Findings from a study conducted by Mills (1999) support the position that teachers’ concerns about and perceptions of an innovation influence how

they implement technology. Teachers' concerns and perceptions regarding computer technology must be considered, however, if schools are to experience significant change or reform with respect to its integration.

Pajares (1992) and Guskey (1986) suggest that a change in beliefs follows, rather than precedes, a change in behavior. Research seems to support this as found in a study conducted by Howard, McGee, Schwartz, and Purcell (2000), where teachers changed their epistemological beliefs to more constructivist beliefs by using constructivist practices. Recent research seems to support the thinking that seemingly resistant beliefs can be transformed by intensive training in teaching strategies that support increased technology integration (i.e., constructivist pedagogies) (Schmidt et al., 2002; Vanatta & Beyerbach, 2000). Schmidt et al. evaluated the effectiveness of the professional development program Integrating Strategies and Technology in Education Practice (InSTEP™). They found that teachers who had completed the program significantly increased their technical skill, attitudes toward technology, constructivist teaching strategies, constructivist teaching philosophy, and constructivist uses of technology. Technical skill, constructivist teaching strategies, attitude toward technology, and constructivist teaching philosophy accounted for 50% of the variance for the teachers' constructivist uses of technology. However, the relationship does not imply causation, i.e., that employing constructivist teaching strategies results in increased technology integration or vice versa. These studies seemed to reinforce the connection between constructivist philosophies and more effective technology integration. Furthermore, this research on changing beliefs showed promise in overcoming resistant beliefs that do not coincide with effective technology integration.

The Influence of Contextual Factors on Beliefs and Attitudes

The influence of the context and the way in which the social structure in a teaching environment influences change in beliefs and attitudes have been overlooked in the study of technology integration (Albion & Ertmer, 2002). These influences can exert powerful forces on teachers, influencing whether they support technology integration. For example, teachers' beliefs about best practices may differ according to subject matter, type of learner, or age of learner. The Teaching, Learning, and Computing 1998 National Survey showed elementary teachers as more constructivist than high school teachers. The results of five case studies by Norton, McRobbie, and Cooper (2000) indicated that individual teachers' resistance to technology integration was related to their beliefs about mathematics teaching (e.g., time constraints exist in teaching many math concepts, must cover a great deal of content and prepare students for examinations) among other contextual factors such as a teaching climate that supports the status quo. Prawat (1992) concluded that problems associated with implementing a constructivist approach could be overcome if teachers were willing to rethink how certain subject matter should be taught in order to foster understanding in students. As Fang (1996) suggested, there may be inconsistencies between teacher beliefs and practices due to the complexities of classroom life, which may constrain teachers' abilities to follow their beliefs and provide instruction that is aligned with their theoretical beliefs. Teachers' theoretical beliefs could be situational and manifested in instructional practices only in relation to the complexities of the classroom.

Figure 2.1 also illustrates the complex interrelationships of factors that influence technology integration, which has been discussed in the research literature.

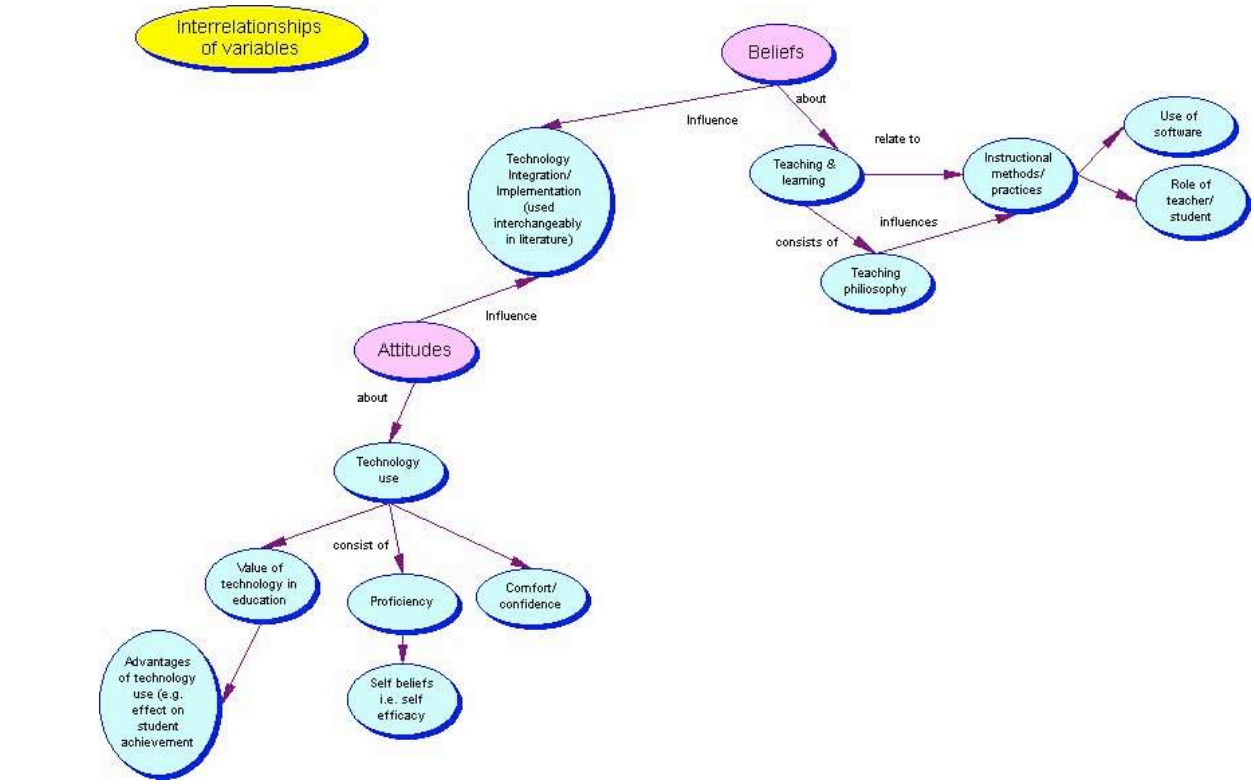

Figure 2.1: Interaction of beliefs, attitudes, and instructional practices

The Value of Technology: The Impact on Student Learning

The literature on the impact of technology on student learning and student achievement dates back to the late 1960s when few public school districts had access to computers (Kulik, Kulik, & Bangert-Drowns, 1985). Since computers have entered public education in greater numbers, thousands of studies have investigated their educational benefits, demonstrating mostly positive effects (e.g., Dwyer, 1994; Fletcher-

Flinn, & Gravett, 1995; Kulik, 1985; Kulik, Kulik, & Bangert-Drowns, 1985; Kulik & Kulik, 1991; Niemiec & Walberg, 1987). But there has been criticism of early studies of the effects of computers on student achievement. For example, most of the research focused on basic skills, not on higher order skills (NCREL, 1999); most studies were of a short duration, and certain researchers may have too narrowly defined student achievement as being the outcome measure (Krendl & Clark, 1994). Studies have been criticized for methodological design flaws: small sample sizes were used, instructional practices and design of computer-based materials were confounded, and computer use was often treated as an isolated variable. On the other hand, the positive effects of computers on learning may be attributed to the quality of the delivery of instruction or the design of the computer-based materials, according to Clark (1983). Upon reviewing research on the learning effects of media in a sample of CAI studies, Clark found that instructional method was not held constant. In studies that used the same instructional approach, there was no effect on student learning from CBI instruction. However, keeping everything constant except for computer-mediated instruction (CBI) is neither feasible nor useful because technology use is not an isolated activity. It is embedded within a context with other mediating variables. A more reasonable approach, therefore, is to investigate technology use contextually because it is a moving target.

Technology use involves many complex interacting variables that can account for some of its positive impact. There seems to be no simple cause and effect relationship between CBI and improved student achievement. Some of the questions arising from the early studies of computers and teaching cite the need to evaluate the impact of technology from a theoretical perspective (Jacobson & Spiro, 1994). What seemed to be lacking was

a perspective that begins with a theory of effective teaching and learning, and conditions under which computer use is optimal. It is also important to frame an evaluation of the effectiveness of technology in terms of a clear definition of learning. Is learning regarded as achievement, measured by traditional standardized tests? Are alternative assessments required to evaluate the effectiveness of different technologies? What are the learning goals targeted? How are they being assessed? Studies varied in how achievement or learning was measured. Some were measured with state standardized tests and others by district-developed tests (Kulik, 1994). Given the many types of computer technologies used in evaluation studies, different technologies may be more suitable for different learning goals. Thus, the assessment of those learning goals should coincide with the learning goals themselves. Furthermore, conditions such as class size, educational level, teacher expertise (pedagogical and technological), nature of the subject matter, and student characteristics would need to be specified and taken into consideration. Based on the studies reviewed, it can be seen that the study of technology use cannot be removed from the larger context in which technology is embedded. Figure 2.2 shows some of the contextual factors involved in the interrelationship of teaching, learning, and technology, which need to be considered in studies of the use of computer technology in teaching.

At the center of this interrelationship are content (of instruction), teachers, students, and instructional contexts. The impact of technology must be seen as part of the larger process of teaching and learning, and thus evaluating the impact of technology requires first an understanding of technology use in a social context with many intervening variables influencing the effectiveness of its use. From these four major components, other influencing variables are related.

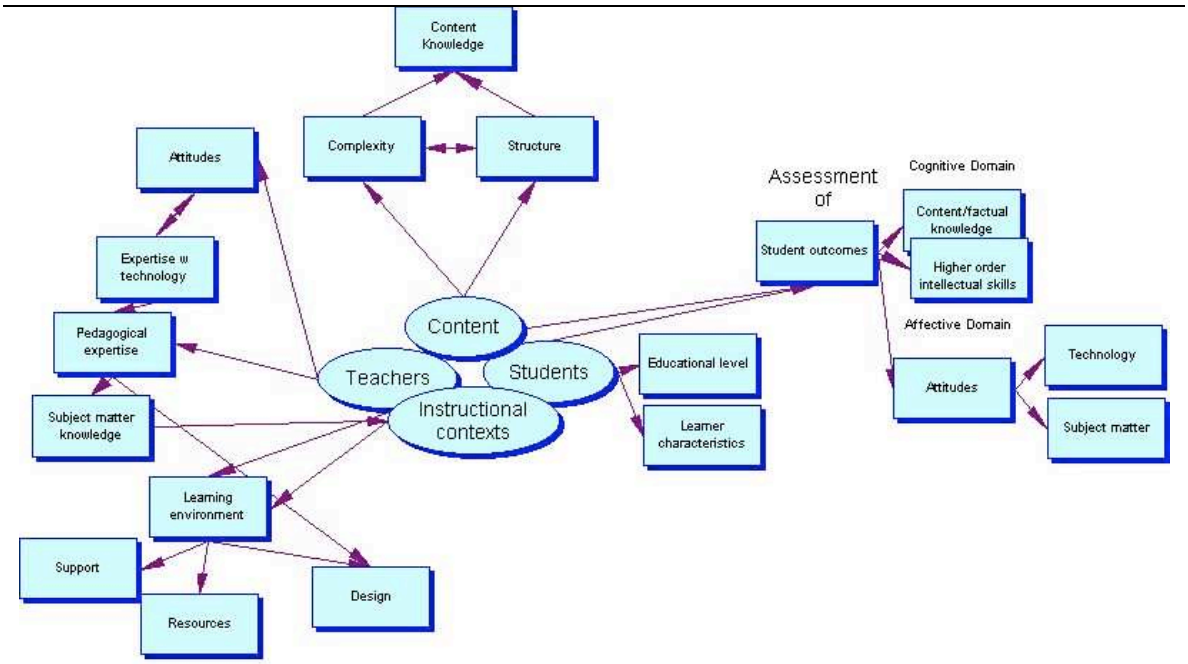

Figure 2.2. Contextual variables in teaching and learning with technology

With regard to students, educational level and learner characteristics may influence the effectiveness of technology use. Some technologies may be more appropriate for secondary students versus elementary students, or with different types of students. e.g., at-risk students or learning disabled students. There are learner preferences for types of learning activities and environments as well as technical skill levels and/or cognitive demands required in different computer environments, which can affect learning. Attitudes toward technology and subject matter content can also be powerful influencing factors on learning outcomes.

Similarly, when content is considered, the complexity and structure of the subject matter can exert different effects on learning, depending on how the technology is used

by the students and teachers and given the affordances of the instructional contexts. Different subject matter content may also lend itself more appropriately to different methods of instruction and learning environments. Context variables would speak to the nature of the learning environment and how characteristics and affordances of that environment may influence how technology is used. For example, lack of support and/or resources affects how technology is implemented. Lack of appropriate, well-designed software might impede learning.

Finally, teacher variables influence student learning in that their expertise in pedagogy, subject matter, and technology all impact how effectively they use technology for instruction. Teachers' subject matter knowledge might influence how they evaluate and select instructional software. Teachers' pedagogical expertise will influence the effective implementation of technology-based instructional activities. Teachers' expertise with technology will determine which technologies get implemented. Teachers' attitudes towards subject matter, students, and technology in general all affect the learning process. Apparently many factors interact to form a complex picture of teachers' beliefs and attitudes in relation to their use of technology in instructional practice. Given this complexity, it is important to focus on the purpose of doing evaluation studies of technology effectiveness. We can only look at parts of the picture at any one time. No broad generalizations can be made, but a picture can be created over time so that investment costs can be justified and education policy makers can feel more confident that technology, used effectively, can enhance learning. In the following sections, each of these major components is addressed in greater detail.

Student Variables

The early studies that evaluated the effectiveness of CBI versus traditionally delivered instruction indicated quite consistently that adding CBI or computer-assisted instruction (CAI) to a school program, on average, improves the results of the program as measured by either local district tests or standardized tests (Kulik, 1994). Kulik (1985; 1994) reviewed many meta-analytical studies that examined the effect sizes of studies, showing mostly positive gains in student achievement as a result of CBI or CAI. However, not all studies showed positive results, and some plausible explanations offered some combination of the following factors: different types of computer use, different types of students, and/or different methods of evaluation of student outcomes. For example, whether students were in elementary school or secondary school had different effects on the type of computer use evaluated. Advantages of computer-assisted instruction were stronger for disadvantaged and low-ability students (Bangert-Drowns, Kulik, & Kulik, 1985) and for males (Niemiec & Walberg, 1985). More positive results for drill-and-practice computer use were found for elementary students than for secondary students. More open-ended computer environments requiring more self-regulation were more effective with secondary students (Brush et al., 1999), while more basic drill-and-practice environments benefited disadvantaged, low-ability, and elementary grade students (Bangert-Drowns, Kulik, & Kulik, 1985; Kulik, Kulik, & Bangert-Drowns, 1985). Moreover, gender differences in boys' and girls' use of computers showed differences in proficiency based on the type of environment (Scott, Cole, & Engel, 1992), with girls having an advantage in computer writing skills (word

processing) and boys preferring game formats and science or math-based programs. Gender differences may influence student learning, depending on the instructional context and the subject matter being taught. Ethnicity plays a part in technology usage and proficiency as well. Minority ethnic groups have limited access to computers and may struggle with English-based programs (Scott, Cole, & Engel, 1992). Evaluation studies need to consider gender and ethnicity factors as they intersect with the instructional context and content.

Another factor to be considered is type of skills being targeted as student achievement outcomes: basic versus higher order skills. Different evaluation studies of CAI used different outcome measures. The studies that have used objective multiple-choice measures (e.g., standardized tests) measuring basic skills would result in more positive results in treatment environments that are similar, and it is these studies that have shown the largest gains (Bangert-Drowns, Kulik, & Kulik, 1985). Furthermore, meta-analytic studies of student attitudes have consistently shown more positive attitudes towards computers (Kulik, 1994), thus influencing students' motivation to learn. However, one caution that has been noted is that the newness of a computer-based learning environment may have had a confounding effect in studies.

Clearly, effects are mediated by an intersection of student grade level, type of student, type of instructional environment, and type of outcome measures used.

Content Variables

The positive effects of computer-based instruction (CBI) can be influenced by content, so the effects CBI ought to be examined in terms of different effects due to subject matter or discipline differences. Fletcher-Flinn and Gravatt (1995) reviewed meta-analytical studies documenting the learning effects of CAI over a broad range of study features and suggested that better quality instruction provided by superior CAI materials might account for the positive effects on learning in CAI environments, thus supporting Clark's notion of why computer use may be positive (1983). For example, instructional objectives tend to be clear, instruction is sequenced with feedback for the learner, and materials encourage participation and activity. When materials were kept constant, Fletcher-Flinn and Gravatt (1995) found no learning advantage with CAI; however, they did show an advantage when materials were different. Interestingly, actual course content (i.e., mathematics, science, arts, etc.) did not produce any significant differences regarding the use of computers for instruction.

Jacobson and Spiro (1994) introduced a framework to help distinguish conditions under which different types of CAI environments could be more productive. Factors such as complexity of knowledge domains (ill-structured versus well-structured) intersects with stage of the learner (beginner versus expert) and type of learning environment (drill and practice, intelligent tutoring systems, microworlds, etc.). Jacobson and Spiro (1994) emphasized how important it is to match the complexity or simplicity of the knowledge domain with that of the learning environment. If the domain is complex and ill structured, then the learning goals require mastery of higher order skills necessitating an

instructional method that accommodates this complexity. Simple and more structured conceptual knowledge should coincide with introductory learning goals, reflecting methods that are more basic and concrete. The very same approaches that typically result in successful learning in well-structured domains for simple concepts have been found to be unsuccessful in ill-structured domains, and may actually impede acquisition of complex concepts at more advanced stages of learning in a domain (Jacobson & Spiro, 1994). It is, therefore, not surprising that elementary students at early stages of learning introductory knowledge show greater effects in computer environments that emphasize drill-and practice-routines (Bangert-Drowns et al., 1985; Kulik, 1985; Niemiec, & Walberg, 1987), whereas secondary students do not (Brush et al., 1999).

Teacher Variables

Another set of influencing variables relates to teachers and must be considered in the large, complex picture of the effects of technology use on student learning. These factors are: beliefs and attitudes, expertise with technology, pedagogical expertise, and subject matter knowledge.

Despite numerous studies of computer use and teaching, no early studies and little current research have addressed the effect of teachers' beliefs and attitudes on student learning. Early studies have shown that when the same teachers are used in comparing the effectiveness of CBI or CAI over traditional instruction, results showed no difference (Fletcher-Flinn & Gravatt, 1995), which indicates that either the teacher was more or less effective and/or the quality of the instructional materials had a more positive or negative

impact (Clark, 1983). In later years, teachers' beliefs about their role in a technology-based environment may be different than in a traditional environment, as suggested by Sandholtz, Ringstaff, & Dwyer (1997), Swan & Mitrani (1993), and Wang (2001). As a result, this change in beliefs and practice has contributed to enhancing student learning. Teachers' positive attitudes towards technology and subsequent increased use (leading to more effective integration practices) have been shown to positively influence student learning as well (Becker, Gearhart, & Herman, 1994; Dupagne & Krendl, 1992; Honey & Moeller, 1990). Many studies have been done relating teacher expertise in technology, learner-centered practices, and comfort level with technology use with more effective technology integration practices (Dwyer, 1994; Jones, 1998; Dwyer, Ringstaff, & Sandholtz, 1991; Pierson, 2001; Sandholtz, Ringstaff, & Dwyer, 1997). More recently, constructivist uses of technology based on constructivist beliefs about learning have been linked with more successful integration practices and enhanced student learning (Becker, 2001, Hashweh, 1996; Prawat, 1992; Schmidt et al., 2002).

There have also been different uses of technology based on subject matter. For example, in mathematics and science, constructivist instructional approaches seem to be more prevalent among high school teachers. Constructivist types of activities requiring students to analyze and write about information and to share information with others have been investigated as part of a study done by Becker (2001). It was found that high school teachers in English and social studies did not use as many constructivist computer-based activities with their students. It may be that teachers' beliefs about what are best practices for different subject matter may be influencing how they use technology in the classroom.

More research needs to investigate the intersection of subject matter with constructivist-oriented pedagogy involving technology use.

Many teacher variables are involved with technology use, and all have an effect on student learning. As Prawat (1992), Pajares (1992), Honey, Carrigg, and Hawkins (1994) in the Union City Project, and Sandholtz, Ringstaff, and Dwyer (1997) (ACOT) have indicated, teachers are the important catalysts in educational reform. Pedagogical and technological expertise in conjunction with beliefs considered consistent with the best technology integration practices (i.e., constructivist, student-centered) have tremendous potential to positively impact student learning.

Instructional Contexts

Depending on the learning goals being targeted, a computer-based learning environment will look different, having been designed so that learners achieve certain specified goals. If the goal is for students to memorize concepts, the appropriate learning environment should be drill and practice, emphasizing lower level cognitive skills. If the goal is for students to develop better problem-solving skills, the learning environment should contain design features that involve students in activities very different from drill and practice. For example, the Cognition and Technology Group (CTGV) at Vanderbilt University (1990; 1994) have designed successful learning environments to help students develop better problem-solving skills in mathematics (e.g., Jasper Series) and science (Mars Mission Challenge), and better reading comprehension skills (Little Planet Series). Their belief is that higher order thinking skills such as problem-solving skills should be

anchored to an authentic context. Activities, therefore, are more realistic and transferable to real-world applications (CTGV, 1990). This is reflected in the design of the learning environment, which allows students to explore the environment, see problems in real-world contexts, and collaborate with others to solve them. In a similar type of environment, i.e., simulation, Weglinsky (1998) assessed the effects of simulation and higher-order thinking technologies on eighth graders and found that the students who used the simulation and higher-order thinking software showed gains in math scores as measured by standardized tests.

Krajcik et al. (1998) designed ScienceWare programs such as Model-It and PIVit to help support inquiry learning in science. Their research has indicated that specially designed technology-based learning environments that provide appropriate scaffolding promote better learning in terms of students being able to carry out scientific investigations. Goldman et al. (1994) developed the Scientists-in-Action series, which consists of multimedia environments for anchoring science instruction in meaningful contexts. In two experiments, they found that students who used the multimedia environment for a chemical spill episode showed greater gains in content knowledge and more positive attitudes toward science and scientists than students who had not worked with the multimedia episode. In a long-term study that spanned seven years, a program designed to assess the effectiveness of Technology Enhanced Instruction for secondary science students prepared them better for post-secondary education (Woodrow, Mayer-Smith, & Pedretti, 2000). An interesting conclusion drawn from their study noted that the technology itself was not the only influencing factor. It indicated that the pedagogical and cultural environment was as influential as the technology. Another interesting insight

from their study was that in student interviews, students talked more about learning than about technology or science. The authors interpreted this as the effects *of* technology – products that students retained from their experiences in the technology-enhanced science classroom. These effects stayed with students long after they left high school as evidenced in follow-up interviews of them two or three years later (Woodrow, Mayer-Smith, & Pedretti, 2000).

Scardamalia and Bereiter (1994; 1996) designed computer-based learning environments to promote collaborative learning. The focal point in this environment is a communal database. Based on research in apprenticeship learning (Collins, Brown, & Newman, 1989) and on communities of learning (Brown & Campione, 1990), Scardamalia et al. believed that organizing a learning environment around a shared database with students having the ability to communicate with each other online would stimulate rich conversations that would give them a substantial knowledge base. In the process of building this knowledge base, the students would engage in reflection on the knowledge shared. The results of their research with this learning environment (computer-supported intentional learning environment or CSILE) indicated that CSILE students greatly surpassed students in ordinary classrooms on measures of depth of learning and reflection, awareness of what they have learned or need to learn, and understanding of learning itself (Scardamalia & Bereiter). Students also did better on standardized tests in reading, language, and vocabulary (Scardamalia et al., 1992). Kulik and Kulik (1994) recognized that different learning environments yielded different results, and hypothesized that some computer approaches produce better results than others. They used a taxonomy that divides types of computer environments (e.g., drill and

practice, tutoring, simulation, programming, etc.). They recognized that evaluation studies should not be done globally. Rather, studies should be grouped together so that the effect size can be compared within similar type computer environments.

Scott, Cole, and Engel (1994) also considered the variety of computer environments employing different strategies. Their classification system for studies of these different environments closely resembled Kulik et al.'s taxonomy. They looked at drill and practice, integrated learning systems, tutoring, instructional gaming, problem-solving tools, word processing, simulations, and hypermedia technology-based learning environments. Differential learning effects were found based on the type of computer use, age and abilities of students, and different subject matter content. For example, developing basic skills in literacy and math seemed to be more effectively accomplished in drill-and-practice environments, whereas higher order learning skills were more effectively developed with problem-solving tools such as Geometric Supposer for geometric inquiry (Schwartz, 1989). Tinker and Papert (cited in Scott et al., 1992) recommended that computer modeling and simulations be used in science education for communication, theory building, creating databases, and programming. Computer-based learning environments, thus, would suit different skills development relative to subject matter content.

Moreover, variables such as support and resources affect how well an environment is used. The successes of the ACOT classrooms (Baker, Gearhart, & Herman, 1994; Sandholtz, Ringstaff, & Dwyer, 1997) and Union City (Honey, Carrigg, & Hawkins, 1998) demonstrate that offering the necessary resources and on-going support (e.g., technical support and professional development) in conjunction with

providing technology-rich environments leads to successful integration of technology that can positively impact student learning.

Contextualized Research

The need for contextualized research on the use of technology in teaching seems warranted, recognizing that student learning will be affected not only by hardware and software but also by the way technology is used and the many cultural variations in the classroom. Many classroom events are tied to each other in a systemic way; therefore, a teaching methodology that respects the systemic nature of the classroom is required. As mentioned earlier, the question of how technology impacts student learning first requires a definition of learning. One definition of learning is the retention of basic skills and content knowledge, which can be measured by standardized tests. Thus, we have seen the positive impact of certain types of technology on learning based on test results, e.g., drill and practice with factual-based standardized tests. Standardized tests may be an efficient way to measure certain types of learning outcomes, but if learning is defined in terms of higher order thinking skills, such as problem solving, the evaluation of the impact of technology on learning will lead to different methodologies. With the growing technological changes, evaluation studies will need to focus on the impact of newly designed powerful technologies that target different learning outcomes. According to Heinecke et al. (1999):

> We have been quite successful in determining the impact of technology on basic information retention and procedural knowledge. However, we have been less

> successful in evaluating the impact of educational technology on higher order or metacognitve thinking skills (¶ 26).

The research literature has indicated that many variables impact on effective technology integration. Although my study does not, nor cannot, address all the forgoing factors, the studies make a compelling statement concerning the importance of taking a contextual approach, which influenced this study. I looked at teacher and instructional context variables since the purpose of this study was to examine the exemplary technology-using teachers' beliefs, attitudes and their effect on instructional practices taking into account the influence of their respective learning environments. Further research involving these teachers could have explored student and content variables, however, these variables were beyond the scope of this study.

Summary

The intersection of teachers' beliefs, attitudes, and instructional practices presents a complex, interrelated process involving contextual/situational factors that influence beliefs, attitudes, and practices in ways that are unpredictable. Perhaps by creating spaces and opportunities for teachers to experience and be supported in exemplary technology use, and taking into consideration the complex context of teaching, teachers may become more powerful agents of change in a reform effort, especially involving the use of computer technology. Providing the models and the opportunities to practice good models of technology integration needs to be considered. These lines of research have tremendous implications for in-service teacher training and teacher education programs.

Studies that help to improve understanding of the complex and interrelated processes involved in teaching with technology can contribute to the continuous growth of teacher professionalism through improved, ongoing teacher support and education. For example, Ertmer (2001) is currently conducting a project called VisionQuest that helps current and future educators envision and achieve technology integration by providing access to electronic models (e.g., multimedia CD-ROMs) of technology-using teachers. It is her belief that technology integration is not achieved just by providing access to technology. Ertmer asserts that:

> . . . the use of technology may be associated more with teachers' beliefs about teaching, the purpose for which technology is used, and the value teachers assign to particular uses of technology. Teachers need opportunities to examine and reflect on the beliefs and practices of other teachers who are currently integrating technology. (¶ 2)

The VisionQuest program makes use of modeling exemplary users of technology as follows:

> The CD-ROM can transport teachers into others' classroom so they can examine the instructional practices, classroom organization, and curricular emphases of exemplary users of technology. They can see for themselves the roles played by the student, the teacher, and technology in a classroom where technology is integrated. (¶ 3)

Thus, changing teachers' beliefs and attitudes may be accomplished more successfully by modeling effective practices so that teachers can see what effective integration of technology looks like and how it is done. This type of project has achieved some degree of success in assisting teachers in changing their views of technology integration and in adjusting their beliefs about teaching and learning in ways that should help them use technology more confidently and effectively (Albion & Ertmer, 2002). Research on the roles that beliefs and attitudes play in technology integration shows great

promise. Understanding how beliefs and attitudes are influenced by contextual factors can also create environments that facilitate technology integration.

Understanding the process of change and feelings about change in educational settings, and the process of how teachers' beliefs about teaching and learning are acquired and influenced by their context can help educational reformers, policymakers, and administrators design more comprehensive technology integration programs to bring about positive change in schools that could significantly improve student learning.

CHAPTER 3

Research Methods

This chapter presents the research methods for this study. The first sections describe how the sites and teachers were selected. This chapter also presents my rationale for using qualitative methods and the grounded theory approach, which guided the study. A description of my role as the researcher, ethical issues, and the specific data collection methods along with my rationale for their selection follow. The chapter concludes with a presentation of the methods I used to analyze the data, and the limitations of the study.

Sampling Procedures

Selection of Sites

The sites for this study were school districts selected on the basis of their richness of technology access and resources. School Districts A and D were recommended by faculty in the Instructional Systems Department of The Pennsylvania State University. A doctoral candidate in Penn State's Instructional Systems Department, who was employed by the school district as a technology coordinator, recommended district B. Furthermore, a year prior to this study, I was involved with another study in this same district, and from my perspective, determined this site to be technology rich. District C was recommended by two faculty members associated with the Teacher Education Program in the College of Education at Penn State University.

The following criteria were used to determine the technology richness of the site:

- Teacher to computer ratio is 1 to 1
- Student to computer ratio at least 5 to 1
- All classrooms and computer labs have Internet access
- Updated computer software includes word processing, spreadsheets, databases, concept mapping, and authoring programs such as PowerPoint in classrooms and computer labs

One of the purposes of my initial site visits was to establish whether the identified school districts met the "technology richness" criteria before I began the data collection process. All four districts met or exceeded these criteria. Table 3.1 summarizes the technology available in each classroom that I observed.

Table 3.1
Technology Resources Observed in the Classrooms

Teacher	**Dist**	**School**	**# Students**	**Technology Equipment**
1	A	Elem Grade 5	18	Internet access, 4 student computers, 1 teacher computer, LCD projector, scanner, printer, access to computer lab across the hall from the classroom
3	B	MS	22	Internet access, 1 teacher computer, 1 student computer, printer, TV connected to computer, access to computer lab down the hall
5	B	HS	22	Internet access, 1 teacher computer, 8 student computers, 2 TVs, LCD projector, printer
6	C	Elem Grade 1	20	Internet access, 1 teacher computer, 4 student computers, LCD projector, smartboard, 2 TVs, printer, access to computer lab across the hall from the classroom
7	C	Elem Grade 5	22	Internet access, smartboard, LCD projector, 1 TV, printer, teacher computer, 11 student computers
8	D	MS	21	Internet access, 1 teacher computer, LCD projector, 1 laptop per student, printer, 1 TV
11	D	HS	19	Internet access, 1 teacher computer, LCD projector, student computer, printer, 1 laptop per student

HS – High School MS – Middle School Elem - Elementary

Moreover, three levels (elementary, middle, and high school) were represented, which would enable me to see if differences could be found among the teacher beliefs, attitudes, and practices at different school levels.

Selection of Teachers

To select the participants for this research, I first conducted reputational sampling to identify exemplary technology-using teachers in the selected sites to be used in the study. That is, technology coordinators and/or school principals in the four identified school districts were asked to recommend teachers who used technology in exemplary ways. It was left to the discretion of the people who recommended the teachers to define what was meant by exemplary technology-using teachers. I emailed the superintendent of each school district in order to get their permission to conduct this study in their district (see Appendix A). The superintendents, upon agreeing to allow the teachers to participate in the study, notified the technology coordinators and/or school principals that I would be contacting them by email for recommendations of exemplary technology-using teachers (see Appendix B). Thus, 14 teachers were recommended and 11 agreed to participate after I emailed each recommended teacher (see Appendix C). After completing the interviews of these teachers, I used theoretical sampling, which is a defining property of grounded theory according to Charmaz (2000). Theoretical sampling is the process of going back to participants with further questions so as to refine emerging categories. Theoretical sampling is used to make these categories more definitive. For this purpose, I asked seven teachers to answer additional questions in subsequent interviews via email, and approached three of them for more extensive questioning in order to help with this refining process. I asked these three teachers more extensive questions because of their willingness to remain accessible, and because they were genuinely interested in the study. This helped me develop a more open, positive rapport with these teachers, which facilitated the interpretive process of the data analysis.

Qualitative Research Design

The purpose of this study was to describe exemplary technology-using teachers' beliefs and attitudes about teaching, learning, and technology use in education while uncovering the process of how these beliefs and attitudes are formed and are influenced by many contextual factors in the school culture. Finally, this study described how the exemplary technology-using teachers' beliefs and attitudes influenced their classroom practices with technology. The beliefs, attitudes, and practices of the identified exemplary teachers and the influences that shaped these teachers comprised the unit of analysis (Babbie, 2002, p. 93). I collected data on the teachers' demographic variables (Appendix D), including age, gender, years of teaching experience, level of grade taught, subject matter taught, educational level, and amount of self-directed training, from all the participants in order to see whether as association between certain demographic variables and the teachers' exemplary technology use might be found for the teachers in this study.

I used qualitative methods to examine the teachers' beliefs, attitudes, and instructional practices, collecting data through semi-structured interviews, classroom observations, and document analyses, along with grounded theory methods of inquiry (Charmaz, 2000; Glaser & Strauss, 1967; Strauss & Corbin, 1998). Denzin and Lincoln (2000) described a qualitative researcher as a bricoleur, suggesting that these researchers employ a variety of methods of data collection and analysis. The choice of research practices depends on the questions that are asked in the research process, and those questions depend on their context, what is available in that context, and what the researcher can do in that setting (Denzin & Lincoln, 2000). For example, I was sensitive

to interrupting the teachers during work hours and did not expect to impose on their personal time to collect my data. Only certain segments of limited time were available in their busy school schedule, however. On the other hand, a strategy such as conducting focus group interviews, for instance, would have been very difficult. Follow-up questioning by email to clarify and confirm data I collected in interviews was much more practical. However, the effectiveness of this strategy depended on whether a teacher responded to my email communication.

The data sources I used to answer each research question are listed in Table 3.2.

Table 3.2
Data Sources Related to the Research Questions

Research Question	**Data Source**
What are the beliefs and attitudes of exemplary technology-using teachers with respect to a) the teaching and learning process, b) the value of technology in education?	Semi-structured interviews Classroom observations Document analysis: teacher lesson plans, course curriculum, teacher websites, student products Field notes
What has influenced the development of the beliefs and attitudes of exemplary technology-using teachers?	Semi-structured interviews Classroom and school district observations District websites, publications Field notes
How have exemplary technology-using teachers' beliefs and attitudes affected their instructional practices?	Semi-structured interviews Classroom observations Field notes

Ultimately, I felt that the three data collection strategies I selected would provide the necessary means to answer the research questions of this study.

Also, I performed data collection and analysis simultaneously in the tradition of grounded theory inquiry (Charmaz, 2000). As categories formed in my analysis of the data, questions about those categories arose, necessitating my going back to the field for

follow up. Instead, I sent follow-up emails seeking clarification of data from my participants. I used inductive strategies to build a theoretical framework that would explain the data.

Rationale for Using a Grounded Theory Approach

I selected a grounded theory methodology within the qualitative design genre because I wanted to develop a theory about exemplary technology-using teachers that describes and analyzes their beliefs and attitudes about teaching and learning and about the value of using technology in education (Research Question 1: *What are the beliefs and attitudes of exemplary technology-using teachers with respect to (a) the teaching and learning process and (b) the value of using technology in education?)*. Furthermore, I wanted to explore the influencing (past and present) environmental, cultural, and contextual factors that could help explain how exemplary technology-using teachers might have developed and maintained their technology expertise (Research Question 2: *What has influenced the development of the beliefs and attitudes of exemplary technology-using teachers?*). Lastly, I wished to theorize the relationship between exemplary technology-using teachers' beliefs and attitudes and their instructional practices (Research Question 3: *How have exemplary technology-using teachers' beliefs and attitudes affected their instructional practices?*).

Since grounded theories are built from data, I did not wish to impose a theory on my data a priori (Strauss & Corbin, 1998). Therefore, I approached my research questions with an understanding of the considerable complexity and ever-changing dynamics inherent in teaching and thus allow the theory to emerge from my data. I felt it was

important to leave open the dialogue between my research participants and myself as the researcher in order to allow my data to inform my theory. At the same time, I did not exclude the necessity of searching for theories in the literature to facilitate my own process of analysis. Grounded theory procedures involve such interplay among the researcher, research participants, and the data so that multiple iterations of data collection and analysis can capture this complexity. In addition, Strauss and Corbin (1998) leave room in their procedures for creativity: "Although grounding concepts in data is the main feature of this method, the creativity of researchers also is an essential ingredient" (p. 12). It is the blending of science and creativity, or art that I found very appealing in the grounded theory approach. As Patton (1990) noted, qualitative analysis involves both science and art. Strauss and Corbin (1998) elaborate:

> It is science in the sense of maintaining a certain degree of rigor and by grounding analysis in data. Creativity manifests itself in the ability of researchers to apply name categories, ask stimulating questions, make comparisons, and extract an innovative, integrated, realistic scheme from masses of unorganized raw data. It is a balance between science and creativity that we strive for in doing research. There are procedures to help provide some standardization and rigor to the process. However, these procedures were designed not to be followed dogmatically but rather to be used creatively and flexibly by researchers as they deem appropriate. (p. 13)

It is this creativity and flexibility guided by rigorous procedures that I found liberating, yet not too nebulous.

Theoretical Perspective and Grounded Theory Procedures

I adopted a constructivist perspective using an interpretive approach (Charmaz, 2000). The research in my study was guided by the participants' interpretations of their experiences related to teaching, which I regarded as their socially constructed realities.

However, I re-interpreted these interpretations to find meaningful conceptual categories (grounded in the data) from which to build a theory.

Grounded theorists code data as they collect it, and through the coding process, definitions and categories begin to emerge. Data collection and analysis are done simultaneously using a constant comparative approach of comparing data with existing data and emerging theory. Concepts and categories are reformulated while formulating theoretical constructs. On the basis of new data, new concepts and categories emerged during this study that required going back to the participants and collecting delimited data to fill conceptual gaps. The aim in this type of sampling (i.e., theoretical) was to refine ideas or concepts that emerged from the data. The end result is the theoretical framework formed by the negotiated meaning making of the experiences between the researched and the researcher. The research process concluded with writing up the qualitative data in a narrative form, having the research participants confirm the accuracy and authenticity of these narratives, and finally making theoretical connections about the data. Table 3.3 summarizes the research design phases of this study.

Table 3.3
Research Design Phases

Step	Phase	Activity
	Research Design Phase	
1	Review of literature	Articulate research questions
		Identify important constructs
2	Obtain recommendations of exemplary technology-using teachers	Identify exemplary technology-using teachers
3	Select teachers	Conduct reputational sampling
	Data Collection Phase	
4	Develop data collection protocols	Select multiple data collection methods: interviews, observations, document analyses (qualitative) Collect qualitative (interviews, etc.) and quantitative data (demographic variables)
5	Entering the field	Simultaneously collect and analyze data ("zig-zag")
	Data Analysis Phase	
6	Analyze data	Use open coding (initial categories); axial coding (assemblage of data in new ways after open coding i.e., building a story connecting categories); selective coding (story line that integrates categories – hypotheses are presented) (Strauss & Corbin, 1998)
		Zig-zag back and forth from collection to analysis and back to collection – extensive use of memoing (process of connecting data with a category or theme); document analysis of teachers' lesson plans, student productions, artifacts, district web sites, etc. Member checks, peer debriefings
7	Theoretical sampling	Ask further questions on the basis of new categories
8	Closure	Theoretical saturation – no more substantial categories, themes emerge
	Write–up Phase	
9	Evaluation of quality of research findings	Negotiate authenticity and faithfulness of reporting with participants (member checks) Conduct peer debriefing
10	Synthesize report of findings	Develop substantive-level theory that explains data describing connecting categories

Justification for Selecting Qualitative Methods

According to the literature, many influencing factors could be affecting technology integration in the schools. It was not the intent of this study to start with a fixed theoretical framework as to what these influencing variables might be. The aim was not to test the existing theories on technology integration but to generate a theoretical framework that indicates how teacher beliefs and attitudes affect their instructional practices with the use of technology. I was interested in what the beliefs and attitudes of exemplary technology-using teachers were, the process of how they were formed, and in investigating influencing factors (e.g., contextual) that have affected these beliefs, attitudes, and instructional practices. Since contextual factors can vary widely, trying to construct a quantitative questionnaire to deal with many of them would have been unrealistic. The study of teacher beliefs, attitudes, and practices through survey methods can only get at the surface of teacher behavior as well as the beliefs and attitudes underlying their behaviors. Thus, I believed that qualitative methods such as semi-structured interviews and teacher observations could lead to more credible data that could reveal what was occurring in the "natural" environment of the school context with regard to the teachers' technology use.

Furthermore, I thought that observations of a teacher's classroom practices in the use of technology might better indicate the teachers' beliefs and attitudes than their self-reports, either through survey instruments or structured interviews. Since some teachers might not be aware of their beliefs and attitudes, I felt that more open-ended, less structured interviewing could provide the opportunity to bring these beliefs and attitudes to their conscious awareness. Teachers' behaviors may not reflect their beliefs and

attitudes; instead, contextual factors may alter their behavior. Going back to the field for confirmation of the data collected provides qualitative investigators the opportunity to get closer to the participants' perspectives through detailed interviewing and observation. Such qualitative research methods allow the investigator to go deeper into the data with the participants in order to reveal thoughts and experiences closer to their realities at that particular place and time.

Along with interviews and observations, document analysis completed my data collection strategies and formed the triangulation of data that serves to improve the probability that interpretations of the data will be found credible (Lincoln & Guba, 1985).

Finally, I believed that listening to teachers tell their experiences in their own words and understanding their teaching/learning context from their own perspectives, while allowing them participation in the interpretive process, would result in greater credibility of the data in this study.

Constant Comparative Method

In this study, I used a constant comparison method, one of the foundations of Grounded Theory (Glaser & Strauss, 1967; Strauss & Corbin, 1998). In building the theory from data, it was necessary to explore data from multiple sources with theoretical sensitivity. I revisited the data and analyzed it through iterations that led to different conclusions or judgments during different points in time. Research questions in grounded theory typically reflect an interest in process and change over time, and the methods of collecting and analyzing data reflect a commitment to understanding the ways in which reality is socially constructed (Charmaz, 2000; Morse & Richards, 2002). The process of

going back to the teachers to further explore concepts was a strategy that helped both the teachers and me articulate more clearly their beliefs and attitudes that influenced instructional practices. We had to work together to construct the pictures of their experiences. This strategy is a part of what Glaser & Strauss (1967) refer to as the constant comparative method, which involves asking questions of the data, then going back to the field to get answers. It also requires comparing concepts across participants to capture variations of the concepts. I was attempting to detect patterns among teachers that are exemplary in using technology, however, I expected to see variations by gender and age.

Ethical Issues

One of the ethical issues considered in this study was that of safeguarding privacy and confidentiality. Participants signed an informed consent assuring confidentiality. Steps to assure confidentiality included removing personal identities from the written research document and removing actual names of the school districts in which each teacher taught. Furthermore, as a researcher, I did not divulge information from teachers to other teachers. However, as a novice researcher, I did not have pre-established ethical guidelines to help in situations in the event that an ethical dilemma presented itself. I was fortunate that the study did not involve me with sensitive information that needed to be safeguarded. I agree with Piantanida and Garman (1999), that, "safeguarding the interests of research participants is less a matter of following a prescribed set of specific guidelines and more a matter of the researcher's developing a strong ethical sensibility"

(p. 153). I did have a concern that since the study involved few teachers in four districts, it may have been easy for teachers within a district to identify other teachers should they be given access to my study. Therefore, teachers were assigned numbers and their respective districts were designated with letter. I asked several teachers if it would bother them if someone from their district were able to identify them. Teachers responded that revealing their identity would not be of concern to them.

Another ethical issue that concerned me was the fact that principals and/or technical coordinators recommended the teachers in this study and they may have felt politically pressured to participate even though participation was voluntary. They may have felt obligated to respond in positive ways that positively reflected on their respective districts as well. My response to this awareness was an over sensitivity to imposing on teachers' time. I may have rushed through initial interviews as a result. The quality of the research may have suffered, but fortunately, I received such a welcoming attitude and was met with excitement about talking about what teachers loved to do. I felt I rushed through my first interview very aware that I may be imposing. However, as the study progressed, I relaxed as I realized teachers welcomed the opportunity to talk about what they do. As far as the issue of teachers' feeling the obligation to be positive and show their districts in positive lights, I did not get an impression that teachers were careful to edit out negativity. I found the teachers in this study to be very positive and enthusiastic about their work and work environments. Any negative comments that did not relate to my research questions were carefully edited out based on my better judgment, however few they were. I do not feel that these edits compromised the quality of this research.

My Role as the Researcher

My role as the researcher in this study was that of a participant observer who interacted extensively with the participants in their naturalistic setting in the schools. I did not interrupt the teachers while they were delivering the lessons that I observed, but rather I interacted with these teachers outside of the classroom lessons. Such interaction precluded being in a dualistic subject-object relationship between the observer and the observed, and that the researcher-researched relationship is mutually shaping. Therefore, as the researcher, I negotiated the interpretation of the data that I collected with the participating teachers. The researcher works to reconstruct an understanding of the participants' experience through a process of synthesizing data so that theories emerge as the data reveals the interconnections (Bogdan & Biklen, 1992), a process that involves confirmability by the participants. "Meaningful human research is impossible without the full understanding and cooperation of the respondents" (Lincoln & Guba, 1985, p. 105).

Furthermore, the researcher brings to the study certain presuppositions and values that not only influence the methodology of the study but also color the interpretation of the data. As a social constructivist and one who believes in subjective realities when it comes to assigning meaning to experiences, the qualitative methodology that I chose for this study revealed this bias. One emphasis of this methodology is on the interpretive process that occurs between the researcher and the participants. The process is hermeneutical and dialectical (Lincoln & Guba, 2000; Van Manen, 1990), which means that the meanings of the data are interpreted through open discussions between the researcher and the researched. Therefore, my interviews with the participants were open

ended to encourage multiple perspectives, both theirs and mine. While my own biases towards the positive value of technology and its worthwhile contribution to student achievement could not be eliminated (R.Q. 1, 3.1), knowing my biases helped me to develop an awareness of my potential to lead the participants in a particular direction when providing data in line with the my own values rather than according to the participants' own experiences. I was aware of my own biases regarding other research questions as well. Since I consider myself learner-centered and have constructivist beliefs about teaching and learning, (R.Q. 1), this was a lens that I used in analyzing my data, but I was careful to ascribe these beliefs to teachers only if I could make connections between the teachers' beliefs and attitudes and what is described in the research literature.

Data Collection Strategies

A grounded theory approach advocates the use of multiple data sources to give the researcher/analyst different views from which to understand a category and the conditions under which it exists (Glaser & Strauss, 1967, p. 106). In this study, the qualitative data I collected were from interviews, observations, and document/artifact analysis. The resulting triangulation of this data helped me to develop theories that explained the underlying relationships among the categories that emerged from the multiple forms of data. My specific data collection procedures were as follows:

- **Interviews**: Through open-ended interviews lasting 60 to 75 minutes each, I probed the teachers' beliefs and attitudes about teaching and learning, their feelings about the value of technology in education, factors that influenced the development of those beliefs and attitudes, and the subsequent effect their beliefs and attitudes had on their instructional practices. (See Appendix E for the interview protocol.) I conducted multiple interviews of teachers in several modes: face-to-face, telephone, and email. I conducted the initial interview of each participant either face to face or by telephone and recorded each interview by making handwritten notes. This method allowed me to adopt a more personal, conversational tone during each interview. The teachers seemed to feel more at ease, and certainly I felt more comfortable with this method because, if I had used a tape recorder during the interview, I would have had to monitor it for tape changes. Since I did not tape either the face-to-face or the telephone interviews, I asked the participating teacher to repeat or re-state the answer to my question if I did not get their full answer written down, or understand it, the first time. This method helped me to confirm what the participant was saying, and to record their interpretation of their experience, and subsequently to make my own interpretation of their responses. This verification process during the interview helped ensure that I was accurately portraying the participant's interpretations. The interviews of the 11 teachers were my primary data source. I asked them questions in the order they are presented in the interview protocol. However, if a teacher struggled with a question, we moved on, returning later to an unanswered question. Usually, subsequent questions helped to stimulate their thoughts about

prior questions. During this process, I gave the teachers enough time to reflect on and consider their responses since I did not want them to feel pressured to respond before they were ready. I felt it was necessary to allow sufficient time to pass before interjecting a probing question to elicit a response. As a result, I procured more detailed reflective responses from which to work, revealing richer dimensions of the teachers' experiences. In follow-up interviews by email, I also clarified the participant's responses, or asked additional questions to obtain more data or detail.

Before each interview, the teachers read and signed the informed consent form required by The Pennsylvania State University for human subject research (see Appendix F). In the case of the telephone interviews, I mailed the informed consent forms to the participant beforehand. After each interview, I read my entire hand-written transcript, made notes of my general impressions, then typed the interview data into Microsoft Word, transferring the files into the software program Atlas TI, a qualitative data analysis management software application. In Atlas TI, I began the open coding process. Since the interviews were spread over four months' time, I analyzed each interview transcript sequentially. However, even while I analyzed the interview transcripts, I began comparing the teachers' responses, going back and forth among their interview data. During this process, I made memos of similarities in wording contained in the teachers' responses. I began connecting certain concepts with one another to form broader concepts or categories (axial coding). Larger, more abstract concepts subsumed smaller ones. Each theme and sub-theme that emerged is explored in Chapter 4.

- **Observations**: My direct observations of the classrooms of the teachers I interviewed complemented their interview data, providing me another interpretive perspective on their experience (See observation protocol in Appendix G). I interviewed all 11 participants, but I only observed 7. Table 3.4 identifies which teachers I observed in each district. However, I felt that with the triangulation of the data and the theoretical sampling—which required an iterative process of data collection and analysis—it was not necessary to observe all the teachers I had interviewed in order to reach saturation of the categories that emerged from the data. According to Charmaz (2000), we are only getting a slice of life, so other means such as my follow-up emails served the purpose of category saturation. Furthermore, logistically, observing all the teachers would have been difficult given the considerable distance between the districts. Besides, observing all the participants would have prolonged the study unnecessarily. The main purpose of the classroom observations was to establish whether the beliefs and attitudes that the teachers talked about in their interviews affected their practices related to their technology use in their classrooms. Prior to each observation, I had met the teacher either through the interview process or during my initial site visit. When I arrived at the school the day of the observations, I made notes of my impressions of the school environment before going into each classroom so that I could determine how these factors might influence the teachers' beliefs, attitudes, and practices, and to gain further insight into the relationship the teachers had with their students and/or administrators. In the classroom, the teachers briefly introduced me to what they were teaching; then I was permitted to sit wherever I

felt comfortable to observe the classroom activities. I did not participate in the lesson and tried not to distract students.

After the interviews, I had the opportunity to talk with each teacher, except Teacher 11, about the lessons I had observed. This gave me an opportunity to write additional memos on my observation forms (Appendix G).

My analysis of each observation consisted of first assessing the setting in terms of functionality, the dynamics of the teacher-student interactions, comfort, and support (technology support and/or teaching support). The second part of my analysis of the observation was an assessment of the classroom activities. I wanted to make connections between the teachers' beliefs and attitudes, as verbalized in their interviews, and their instructional practices, from both their interviews and my observations. Furthermore, I wanted to get a sense of how these teachers used technology. I used two frameworks to focus my observations (and to analyze the teachers' instructional practices as revealed in their interviews): Barbara Means' classroom variables (Means, 2003) (See Appendix H) and the indicators of engaged learning (Meaningful Engaged Learning Framework) of Jones, Valdez, Nowakowski, and Rasmussen (1994) (see Appendix I). These frameworks helped me to focus on important variables and indicators related to the teachers' effective instructional strategies.

I also used the International Society for Technology in Education's (ISTE, 2000, p. 306) technology standards for teachers, i.e., the National Educational Technology Standards for Teachers (NETS for Teachers) as a guideline to

evaluate the 11 teachers' applications of technology-enhanced instructional strategies (see Appendix J).

Finally, I used extensive memoing to capture common concepts and categories that emerged from the interview data, observations, and the documents/artifacts I obtained from the teachers

- **Document Analysis**: My data sources also included 10 teachers' lesson plans, instructional materials, 5 teacher websites, some of the students' products both in electronic or non-electronic form, as well as other text documents that provided information related to how technology is being used by these teachers and their students. The student products that were analyzed were those I asked teachers to demonstrate. I examined teacher and student products for evidence of the teachers' beliefs and attitudes about teaching and learning with the use of technology. For example, I evaluated the type of products students worked on as well as the teachers' lesson plans, curriculum, and websites. I was looking for evidence that the student products had real-world connections, that they targeted higher order thinking skills, that a variety of technology applications were being used, and that lessons or activities reflected the grade-appropriate skill level in technology. Again, the NETS for Teachers (ISTE, 2002, p. 306) served as a guideline for my document analysis (see Appendix J). In addition to the technology standards for teachers, I used the frameworks of Means (Appendix H) and Jones et al. (Appendix I) to guide my interpretation of the teachers' beliefs, attitudes, and practices. Table 3.4 summarizes the data I collected for each participant.

Additionally, I examined the district websites for their mission statements, goals, and belief statements that might influence the teachers' beliefs, attitudes, and practices. These are shown in Table 3.5. I interpreted each district's culture through its public representation of itself through its website and their various print publications. I compared what was articulated in the web publications with what I observed during my multiple site visits and what the teachers said during their interviews. For each document analysis, I included the nature of the document, the date it was created and by whom, and its purpose and significance. (See the document analysis protocol in Appendix K.)

Table 3.4
Summary of the Data Collected

Interviewed Participants	**District**	**School**	**Observation**	**Follow-up Phone Calls/Emails**	**Document Analysis, Artifacts**
1* Face-to-Face 9-3-03	A	Elem.	1 (1 hr.) 9-3-03	Multiple emails	Student spreadsheets, teacher website, Internet sites selected by the teacher, 2 lesson plans from observations
2 Telephone 7-29-03	B	Elem.		1 follow-up phone call	Online curriculum
3 Telephone 8-21-03	B	Middle	1 (50 min.) 6-3-03		Teacher website, student websites, student art projects, 1 lesson plan from observation
4* Face-to-Face 7-30-03	B	Middle		Multiple emails	Class website, teacher website, 3 lesson plans
5* Face-to-Face 6-18-03	B	High	1 (50 min.) 5-29-03	Multiple emails	Teacher website, 1 lesson plan from observation
6 Face-to-Face 9-5-03	C	Elem.	1 (50 min.) 9-5-03	2 follow-up emails	Student display of digital photos, district online curriculum (Knowledge Box) Monarch butterfly project, 1 lesson plan from observation
7 Face-to-Face 9-5-03	C	Elem.	1 (50 min.) 9-5-03	1 follow up email	Student social studies project folder on smart board, Knowledge Box curriculum, 1 lesson plan from observation
8 Face-to-Face 6-4-03	D	Middle	1 (50 min.) 6-4-03		Class poster on Flight 93, social studies curriculum (online)
9 Face-to-Face 9-25-03	D	Middle			Course syllabus
10 Face-to-Face 9-25-03	D	Middle		1 follow-up email	
11 Face-to-Face 9-25-03	D	High	1 (50 min.) 9-25-03		Teacher website Internet lesson plan

*Teachers selected for further questioning.

Table 3.5
District Data Collected

District	Web Documents	Artifacts
A	• Technology Plan • Technology Mission Statement • District Mission Statement • District Goals • Integrating Technology into Curriculum Resources	
B	• Technology Plan • District Goals • District Mission Statement • Belief Statements • Course Catalogue	• Newsletters
C	• Elementary School Website • District Mission Statement • Resources Links for Students • Educational Links • Online lesson plans	• Survey on Reading Curriculum Implementation • CD slide presentation, • District Education Foundation brochure, • Network connectivity plan for school and surrounding area • Newspaper article
D	• Strategic Plan • Mission of School District • Belief Statements • Educational Goals	• Blue Ribbon Technology Report • Newsletters

- **Demographic Information**: I collected data on seven demographic variables from the teachers (see Appendix D), the results of which are shown in Table 3.6. My intent was to investigate whether there were differences in these variables among the exemplary technology-using teachers. I collected this data at the beginning of the first interview session at the same time that the teachers read and signed the informed consent form, except when it was mailed to them. I mailed the informed consents to the teachers whose interviews were conducted by telephone before the interview. The first telephone contact was to set up the interview and get the address where the teachers wanted the informed consent

form to be mailed. After the interview was conducted, I reminded the teachers to return the informed consent in the return envelope I provided them.

Table 3.6
Teachers' Demographic Variables

Participant	District	Age	Gender	Teaching Exp.	Grade Level	Subject	Educ. Level	Home Computer Use/wk
1	A (E)	50-59	M	25	5	All	MEd +	15
2	B (E)	30-39	F	13	4	All	Master's	1
3	B (MS)	50-59	F	31	6-8	Art	Master's	7
4	B (MS)	30-39	F	11	6-8	Gifted	Med+	10-20
5	B (HS)	30-39	M	12	11-12	Physics	MEd +	15-20
6	C (E)	40-49	F	5	1	All	BS +	7
7	C (E)	40-49	F	25	5	All	Master's	5
8	D (MS)	40-49	M	18	8	S.Studies	Master's	10
9	D (MS)	50-59	M	31	8	Math	MEd+	10
10	D (MS)	20-29	M	5	7-8	History	MEd +	15-20
11	D (HS)	30-39	F	10	9-12	English	Master's	5

E – Elementary MS – Middle School HS- High School Med – Masters of Education

Data Management and Analysis

I stored and analyzed all the data I collected, including my interview transcripts, my field observation notes, and document data using Atlas TI, which aids in theory building by supporting linkages in the data. Codes may be formed out of the raw data that Atlas TI represents by various coding networks. Coding involved continuous conceptualizing of the data by linking it with ideas. I used the following coding procedures in this study as recommended by Strauss & Corbin (1998):

- With *open coding*, I formed the initial categories of information that emerged from the data, looking for properties and dimensions that characterized these

categories. Through a process of line-by-line coding, I broke down the data and assigned conceptual names or labels to the categories.

- With *axial coding,* I rearranged the data in new ways after open coding, relating categories to sub-categories at the level of properties and dimensions. This process involved situating a category within a context and addressed questions about how, when, where, and under what circumstances a phenomenon existed.
- *Selective coding* was the final process in which I integrated and refined the data into a theory. At this point, no more categories or relationships were emerging, having achieved theoretical saturation. Then, I chose the central category of the study and linked the subordinate categories to it.
- During this analytical process, I used a technique called *memoing*, or reflective note taking, whereby I hypothesized categories and their properties and dimensions, and how they might be linked to other categories and their respective properties and dimensions.

Quality of the Research

In the naturalistic inquiry process, I employed certain modes to verify and confirm the trustworthiness of my data, which contributed to the credibility of the findings. Credibility points to the truth-value of the research results. To increase the probability that the findings would be credible (the naturalist researcher's term for internal validity), I used triangulation, peer debriefing, and member checks, as recommended by Lincoln and Guba (1985). Triangulation involved the several different

data collection modes. In this study, I conducted face-to-face, telephone, and email interviews, which varied in length). My classroom observations of the teachers and my analysis of school district documents complemented my interview data, to complete the triangulation of the data.

Additionally, I conducted peer-debriefing sessions during the research, which consisted of conferring with a disinterested peer during the analysis of the data to expose my biases as the researcher. Two peers were researchers from the Instructional Systems Department and two were experienced elementary teachers in districts unconnected to this study. Exemplary technology-use was not a criterion for selecting these peers. The de-briefing sessions served the purpose of clearing any feelings I had that may have clouded my judgment and prevented the next logical steps in the research process.
I relied considerably on member checks that I conducted with participants in the study through email exchange. The participating teachers reviewed my interpretations and constructions of the data by reading my narratives based on our interviews to verify that I had adequately represented their experiences.

To create an audit trail of my methodological processes, I used:

- raw data, write ups of field and theoretical notes
- process notes, including procedures, designs, strategies, and rationale
- instrument development, e.g., observation formats, interview protocols, and document analysis protocol.

Finally, to facilitate the transferability (generalizability) of my findings to other contexts, I made rich and thick descriptions of the learning contexts along with field notes on the interactions of the teachers with their contexts.

Limitations of the Study

The first limitation of this study, as mentioned in Chapter 1, is the inability to generalize the findings from this study to other settings. As Lincoln and Guba (1985) stated:

> . . . generalizations are assertions of *enduring* value that are context free . . . their value lies in their ability to modulate efforts at prediction and control. Generalizations are not found in nature; they are active creations of the mind. Empirically, they rest upon the generalizer's experience with a limited number of particulars. (p. 110, 113)

This research study examined context variables and their influence on the beliefs, attitudes, and practices of exemplary technology-using teachers at three school levels. Their beliefs, attitudes, and practices could not be interpreted or understood without a context, however. Instead, Lincoln and Guba (1985) discuss transferability or fittingness of a study's findings. They define "fittingness" as the degree of congruence between two contexts (p. 124). Thus, to the degree that a context is similar to the one in this study, one could apply the lesson learned. Furthermore, theorizing about the exemplary technology-using teachers for the purposes of transferring lessons learned to similar contexts is limited due to the small number of participants of this study. Creswell (2003, p. 122) suggests using 20-30 participants.

The second limitation of this study was the fact that the interpretations of beliefs and attitudes depended on the conscious awareness that participants have of their beliefs and attitudes. Quality interpretations also depend on how skillful the researcher is in helping participants render these beliefs, attitudes, and connections to instructional practices more explicitly. These issues influence the depth and richness of the mutual

(researcher and researched) interpretations of data collected that reveal the teachers' beliefs, attitudes, and instructional practices using technology.

This second limitation was mitigated by using the grounded theory method of constant comparison (Glaser & Strauss, 1967; Strauss & Corbin, 1998), which involved going back to the field to collect more data to support my interpretations. This limitation was also mitigated by developing an open rapport with participants and engaging them in the interpretive process. Often, it was necessary to do member checks (Lincoln & Guba, 1985) in order to re-confirm interpretations of what participants had said in their interviews. Such techniques helped establish what Lincoln and Guba call trustworthiness. Trustworthiness contributes to the truth-value of the interpretations made in this study and the theories resulting from the interpretations of the data.

The third limitation of this study was the potential bias that I brought to the investigation. I consider myself an advocate of technology integration and embrace the value of effective use of technology in teaching and learning. I also have preconceived notions of what constitutes effective use of technology, not only from personal experience but also through extensive reading of the literature on technology integration. Thus, all the data I collected and analyzed was filtered through these biases and preconceived ideas. This limitation was counteracted in one way by the coding process. Charmaz (2000) explains how line-by-line coding of the data helps prevent a researcher from imposing their extant theories or their own beliefs on the data. Line-by-line coding keeps the researcher close to the data, and using what Charmaz calls "sensitizing concepts" (p. 515) aids the researcher in organizing and understanding another's

experiences by using many of the participant's own words so that their realities are reflected in the data.

Another way I was able to guard against imposing my biases and beliefs was to frequently ask participants during the interview process to summarize or clarify their statements to ensure that I was faithfully representing their beliefs rather than my own. Finally, member checking of the data write-ups aided in the process of editing out any of my personal, superimposed beliefs.

Summary

This chapter has described the grounded theory methodology, which guided the methods and strategies I used for the data collection and analysis in this study. I have described my data collection and data analysis methods and provided my rationale for using these methods, as well as my justification for using qualitative methods along with a disclosure of my participant-observer role as the researcher in this study. Finally, I have discussed the limitations of the study. The following chapter presents the results of my analysis and the findings of this study.

CHAPTER 4

Data Analysis and Finding

This chapter describes the findings of this study. The findings are presented following the data analysis framework: The Personal Domain, The Cultural/Environmental Domain, and the Pedagogical Domain. Next, I describe teachers' definitions of beliefs and attitudes and provide a rationale for its inclusion in the analysis of the data. Finally, the themes that emerged in this study are explored.

The Data Analysis Framework

Figure 4.1 illustrates the data analysis framework that emerged from the study. At the top level, the framework presents three domains: The Personal, The Cultural/Environmental, and the Pedagogical. At the next level, each domain was comprised of themes that characterized that domain. The Personal Domain had three main themes: (1) teachers' own definitions of the two main constructs of this study i.e., beliefs and attitudes, (2) teachers' self-beliefs, and (3) personal beliefs about learning. The Cultural/Environmental Domain was comprised of a characterization of teachers' early learning influences and current supportive, resource-rich learning environments. The Pedagogical Domain's main theme was pedagogical expertise. The third level represented sub-themes identified at the second level. This framework helped structure my analysis and the presentation of the data.

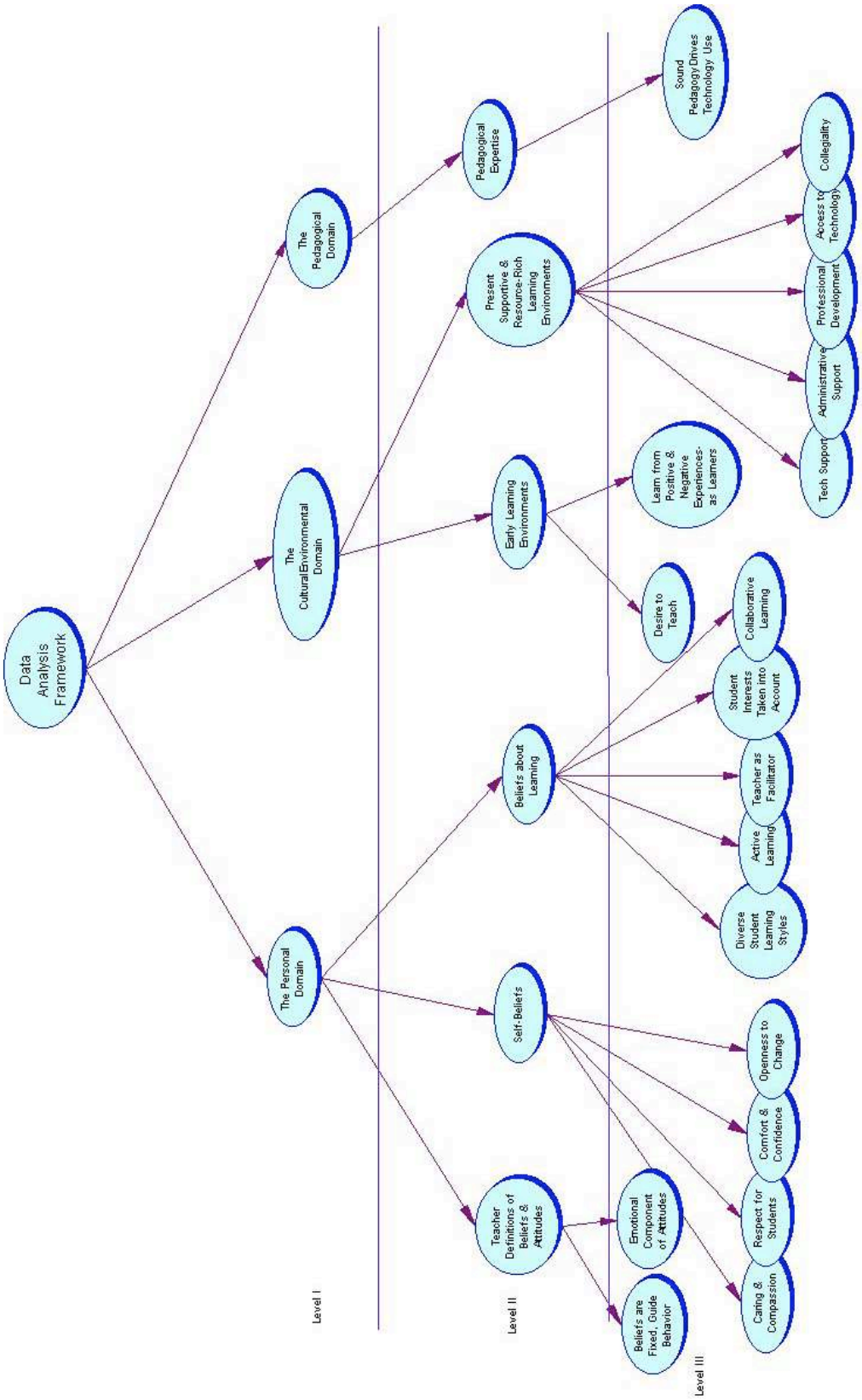

Figure 4.1
Data Analysis Framework

The Personal Domain

Definitions of Beliefs and Attitudes

In this section I discuss how teachers defined the two major constructs of this study in an attempt to establish an explicit understanding of these constructs. This study explored the beliefs and attitudes of exemplary technology-using teachers, what influenced and shaped the development of these teachers, and how these particular beliefs and attitudes affected their instructional practices. I believed that before discussing beliefs and attitudes about the teaching and learning process and their effects on instructional practices, a conversation about teachers' understanding of what beliefs and attitudes were might serve as a catalyst for reflecting on beliefs and attitudes connected to the teaching and learning process and the subsequent connection between beliefs and attitudes and instructional practices. This was an important first step to bring these beliefs and attitudes to a more conscious level. It was not as important to agree on the distinction between beliefs and attitudes, but more important that we understood that beliefs and attitudes have some connection to behavior and instructional practice.

The consensus was that beliefs were deeply ingrained and not easily changed. Teachers seemed to agree that beliefs were internalized ideas or thoughts that guide behavior. The following quotes in Table 4.1 provide evidence of the shared understandings teachers had of what constitutes "beliefs":

Table 4.1
Teachers' Definitions of Beliefs

Teacher 1	Beliefs are internalized, very deep and embedded that guides behavior and how we live; it is personal and sometimes not at a conscious level.
Teacher 4	Beliefs are guiding philosophies and principles formed over a very long time.
Teacher 5	Beliefs are philosophical ideals that make people do the things they do.
Teacher 8	Beliefs are ingrained, something you live by.
Teacher 9	Beliefs are things that are set in your heart – things that truly influence what you do and how you do it, even if unconsciously.

The definitions of attitudes, on the other hand, showed more variation in how teachers defined the meaning of the construct. The common idea that emerged was that attitudes are not as fixed as beliefs i.e. attitudes could be more easily changed and are connected in some ways to beliefs:

Table 4.2
Teachers' Definitions of Attitudes

Teacher 3	Attitudes are what I feel about something.
Teacher 4	Attitudes are feelings that emerge with the interplay between an individual's belief system and the environment (people, places, events). More easily modified. An attitude can be adjusted without drastically changing a belief system.
Teacher 5	Attitudes are the veneer. Attitudes are the emotional responses to the environment and to society.
Teacher 8	Attitudes are your perceptions, how you feel about something.
Teacher 9	Attitudes, I have found my attitudes changing as time goes on.

The common idea expressed about attitudes seemed to be, according to the teachers in this study, that attitudes have an affective component to them with the characteristic of being more amenable to change, whereas beliefs have intellectual/cognitive components, are more deeply internalized, and are more likely to be resistant to change. Implications were that attitudes may be more easily modified with consistent training and support, but recent research indicates that specifically designed

training in constructivist, instructional practices, for example, can transform teachers' epistemological beliefs (Howard, et al., 2000). As Pajares (1992) suggested, teachers, when confronted by novel situations in which they lack knowledge and cognitive structures, fall back on their beliefs to guide the decisions they make. Therefore, beliefs and attitudes may be changed *during* the process of instructional practice. It may not be a sequential process i.e. Beliefs and attitudes→instructional practices in a change effort. This idea will be further elaborated on in the section on learner-centered practices.

Once teachers reflected on these constructs, the exploration deepened by probing an awareness of teachers' personal beliefs and attitudes in connection to the teaching and learning process. Exploring beliefs and attitudes crisscrossed a landscape of how teachers saw themselves as human beings and how they saw themselves in their roles as teachers in the teaching-learning process. In the following section, teachers' self-beliefs are discussed.

Self-Beliefs

The first part of research question #1asks, *what are exemplary technology-using teachers' beliefs and attitudes about the teaching and learning process*? In answering this question, I felt that connected with these beliefs and attitudes was how teachers see themselves personally in their roles as teachers in this process i.e. their teacher identity. In the process of exploring these identities, predominant personal characteristics surfaced. The rationale behind this exploration was that I wanted to make a connection between how teachers see themselves in their roles as teachers and who they are as human beings. The value of such an exploration was that if there were certain qualities or characteristics

and attitudes (dispositions) that were consistently related to exemplary technology-using teachers, they would be worthy of attempting to develop in teachers, pre-service or in-service. Furthermore, the intent driving this study was to create a framework for professional development to help encourage and develop not only content and technical knowledge and skills related to successful technology integration, but also attitudes or dispositions that exemplary technology-using teachers exhibit that contribute to successful technology integration.

In the next four sections, teachers' self-beliefs gleaned from the interviews, observations, field notes, and document analyses are explored.

Caring and Compassion. Characteristics either explicitly stated in self-descriptions or observed in classroom interactions for all teachers were caring and compassion. Caring and compassion were words used in teachers' self-descriptions:

Table 4.3
Caring and Compassion

Teacher 3	I showcase students' work to show I care about their work, it doesn't have to be perfect….
Teacher 7	I have compassion and care for students… I treat a student as a whole person, besides the academics. I look at the social and emotional aspects of a child so I am able to tell what is going on with kids that may or may not interfere with their learning.
Teacher 8	I'm flexible, relaxed, compassionate, caring, …participate in students' lives, help with after school activities, the yearbook, science club,…I do a lot with kids after school showing interest in their interests.
Teacher 11	I take my teaching job seriously, it's a huge part of my life. I'm dedicated….go to my kids events to show I care. I'm organized, multi-tasked, compassionate.

Caring and compassion were implicit in the conversation with Teacher 2 and 3 as they stressed the importance of inclusion in their classrooms. They included students

with disabilities as a way of showing other students how students unlike them have worthwhile qualities and that these children with identified learning disabilities can learn perhaps not in ways that regular students can. One student was handicapped and in a wheelchair. This disability prevented this particular student from doing many of the tasks other students did, however, this student found ways of using a computer mouse to create artwork that instilled a sense of pride in the work she accomplished. For Teacher 3, it was important to help develop all students' unique skills not just those of the best and brightest. All children, she said, could learn and lessons students learn in class are not always about academic content. Teacher 2 expressed much of the same sentiments and welcomed learning support students because she felt it was important for these children to have role models in a regular class. Role modeling, she believed, worked both ways. The learning support students offered something to regular students as well; and it was up to her to find each student's unique gifts so that all contributed something of value.

In an observation with Teacher 1, he demonstrated compassion and caring by instituting a classroom practice I thought was quite humane. This teacher also describes himself as "humane". In a large group question-answer exchange, this teacher gives students the option of "pass or play". When called to answer, students have the option of saying pass or play depending on if they are ready to give an answer. According to Teacher 1, this practice removed the uncomfortable feelings students might experience when they cannot answer a question. In a subsequent conversation with Teacher 1 following an observation, he said he understood students feel pressure to answer correctly, and that their egos may be negatively affected in situations where they are

called upon to perform but cannot at that given time. Not only caring and compassion are exemplified, but also a respect for children and their feelings.

This attitude of caring and compassion was addressed explicitly in all of the districts:

Table 4.4
District Caring and Compassion

District A	I appreciate how you have all made me feel very comfortable and at home. I can see that faculty, staff, and students, as well as the community, values a very caring and considerate environment for learning and growing. (Assistant Principal's Welcome on District Web Page)
District B	It is through the efforts of our dedicated staff and involved community to provide a safe and nurturing community for excellent teaching and learning where students prepare to become creative, critical thinking, lifelong learners. (Elementary School Principal's Statement)
District C	Caring and responsible attitudes create respectful individuals. (District C Belief Statement)
District D	Young people are valued, contributing members of society. (Belief Statement)

In a more indirect way, District A also, made references in their District Community Web Page to regarding students not just academically but also socially and emotionally. There seemed to be a concern for the whole child and this was realized in student activity programs that meet students' academic, social, and emotional needs. There are a variety of outside activities for K-12 students. At the elementary level,

> Student Councils, Homework and Computer Clubs, Band, Orchestra, Chorus, and Safety Patrols are prevalent. PTO activities are at the heart of each school, but they do more than raise money for student activities. Last year money was donated to Habitat for Humanity, the SPCA, and to local food banks and the Red Cross.

At the secondary level,

> Band, Orchestra, Choir, Chorus, Student Council, National Honor Society, Yearbook, and SADD are just a few of the nearly fifty clubs and activities active in the secondary schools.

This indicates not only caring about students but also caring for the community that provides excellent models for students to emulate.

Respect for Students. Another characteristic that was explicitly discussed or directly observed was a genuine respect for "kids", which also seemed to be inextricably woven with a genuine enjoyment of them. Teachers either verbally said they enjoyed and respected kids when they described themselves or I observed this phenomenon directly in classroom practices:

Table 4.5
Teachers' Respect for Students

Teacher 5	My attitudes about learning have softened some as I have become a parent. I now look at each of my students as someone's child. They deserve a teacher that will treat them kindly and respect them for the individuals that they are. They deserve a teacher that is patient and respectful and understanding of the process of being an adolescent.
Teacher 8	I like kids, enjoy kids, have fun with them…
Teacher 9	If you are going to stay teaching in the middle school as long as I have, you've got to enjoy kids. I've been teaching for over 30 years.
Teacher 11	I love working with kids. It keeps me young, they keep me reminded of what I don't want to lose as I get older…curiosity, excitement about new things, about the future.

Respect for kids was also exemplified when teachers showed concern for motivating students and engaging them in active learning activities.

During observations I saw respect exemplified in a senior high school class (grade 12), where many students would not be expected to attend classes during the last couple of days in the school year. However, in Teacher 5's class, most students were in attendance, highly engaged in a review just before their final exams. Teacher 5 had created a jeopardy game using PowerPoint. Students were paired at tables in the lab and

on each table was a buzzer to be used when the team knew an answer to a question projected under the game square. Great time and effort went into the technical design of the activity, which he shared with other teachers later on. Students benefited from the activity along with the in-between mini-reviews. If a correct answer was not found after several teams' attempts, Teacher 5 provided a mini-review connecting the correct information under the jeopardy square to a lesson they had done earlier in the year. Elaborations were also given when answers were correct.

In Teacher 8's class at the middle school level, students did a variety of activities where technology was woven in with non-technology activities e.g. students paired up and used laptop computers to do Internet searches, then re-assembled for a large group discussion of what they found. Students had come to class early and remained after class to ask questions. The interactions between teacher and students seemed animated. It was apparent to me that students were interested in the lesson content and motivated to participate. After class, the following period was a planning period for this teacher at which time I was able to discuss the lesson. Students who did not have a class that period wanted to stay in his class to do homework. The classroom was set up with comfortable chairs/sofas at the back of the classroom where students could be more relaxed and less formal. The impression left on me was that 1) the teacher wanted to create a comfortable environment for students and he enjoyed having them around, and 2) students responded positively by choosing to remain in this environment.

In an observation with Teacher 1, I noticed how this teacher addressed his students. For example, in a brainstorming exercise all students' ideas were given merit, even the ones that seemed very incongruous. Teacher 1 found something of value in each

response so no student felt he or she did not contribute a viable idea. In another situation with Teacher 7, I thought she showed tremendous respect for her students' ability to be responsible. She has a practice of allowing students to take turns in releasing students to their buses at the end of the school day. Students in the class showed respect to the student who was assigned to do this task. I was struck at how orderly they could conduct themselves. Overall, for grade five students, I was impressed by their ability to be self-monitoring and respectful of each other. It is my conjecture that these students had a good model of respect shown to them, and they demonstrated they were capable of doing likewise with each other.

Finally, in all four districts, there were explicit references to student respect in belief, goals, and/or mission statements:

Table 4.6
District Respect of Students

District A	District A is committed to the use of all available resources to provide quality instructional programs through which all students will develop their greatest potential, demonstrate mutual respect, work cooperatively to achieve clearly stated goals. (Technology Mission Statement) We believe that all individuals will be treated with dignity and respect. (Belief Statements)
District B	We at District B are committed to the use of all available resources to provide quality instructional programs through which all students will develop their greatest potential, demonstrate mutual respect, work cooperatively, value the learning process, and prepare for a productive role in society. (Elementary School Principal's Statement)
District C	District C will: provide a safe educational setting that facilitates respect for persons, property, and individual beliefs. (District Goal Statement)
District D	Respect for self and others promote a sense of community and environments conductive to learning. (Belief Statement)

Moreover, my own observations during my site visits indicated that teachers and students were respectful of each other. My overall impression was based on how

teachers and students talked with each other and how students talked with one another outside of class. This respect seemed to be reflected in a respect for school property as well. All schools I visited looked clean and well maintained.

Comfort and Confidence. Comfort and confidence with teaching and technology use due to experience were other characteristics shared by teachers in this study. This was also born out in observations where it was apparent that all teachers observed conducted themselves with comfort and confidence, and showed enthusiasm and genuine enjoyment of not only the students but also the process of teaching. This was not surprising since nine out of eleven teachers had over ten years of teaching experience while the remaining two had at least five. Teaching experience seemed to help these teachers become more comfortable and confident in their roles as teachers, which contributed to their pedagogical skill. This comfort and confidence seemed to also carry over to teachers' use of technology. This was also not surprising since they were identified as exemplary technology-using teachers. Comfort and confidence with technology use was discussed in terms of the need to improve practices and try new things. Each teacher interviewed mentioned that they used technology regularly in their teaching and felt the need to continue to improve their technology skills. Teacher 6 talked about how using technology raised her level of comfort. In her own words, she explained:

> Now with using technology in my classroom and learning more each day, I have become very comfortable using it and love to try out new innovations. Technology is the key to student success. With all of the advances in technology today we need to use it in education so our students will be comfortable with it throughout their years in school.

Teacher 7 expressed very similar thoughts when talking about changes brought about by technology:

> Kids need to have the benefits of what might work better. I used to be afraid, but feel safer now, its easier, takes less time to learn and I have more confidence.

Moreover, home use of computers was high among the teachers in this study.

In table 3.5, all but two teachers used computers at home seven or more hours per week. For the two teachers that used home computer five hours or less per week, this was because they spent time at school planning lessons using school computers on their own time i.e. during planning periods or after school. If the question had been worded differently on the demographic variable form (Appendix D) to include the option of school computer use after regular school hours, these hours probably would have been considerably more.

Observations showed teachers using computers quite confidently and comfortably as well. Comfort and confidence with technology seems to be connected to using technology consistently. This finding supports other research findings relating comfort and confidence with higher levels of technology use and more successful technology integration practices (Becker, 1994; Ravitz, Becker, & Wong, 2000; Sandholtz, Ringstaff, & Dwyer, 1997). Schecter (2000) also found a strong positive association between consistent and sustained personal computer use by teachers and higher levels of technology implementation/integration.

Finally, in observations of students using computers and computer peripherals, I could see that they also felt very comfortable using the technology and displayed a high level of skill in the projects they produced e.g., web pages, concept maps, web-based

portfolios, and multimedia presentations using iMovie. My conclusion was that teachers' provided good models of technology use.

Openness to Change. Other characteristics often repeated in teachers' self-descriptions were openness to change/innovation, need to be flexible, and willingness to try new things. Teachers were asked how they felt about change or innovations. This question was posed after asking teachers to talk about their beliefs about how learners learn. Beliefs and attitudes about how learners learn will be addressed in the next section. It was a natural progression to continue the conversation about trying new things after teachers talked about their beliefs about how children learn. In all interviews, teachers seemed animated and excited when talking about teaching and trying new ideas. This excitement about improving practices was evident as well. Teacher 7 said she felt that students deserved her best practices while other teachers expressed very similar sentiments as well:

Table 4.7
Teachers' Openness to Change

Teacher 1	I'm continually improving as an educator, keeping current with best practices, up on research. I've tried many things that I have learned at conferences and courses. The more I try new things the better I am at it.
Teacher 3	I'm like a gardener, always planning, enriching soil, nurturing it, cultivating it, I'm excited about students' growth, their work is the product and I help them grow. A teacher is a good gardener…takes time and pride in developing students…like flowers.
Teacher 4	I enjoy the challenge of change…believe that a student-centered classroom is vital for meaningful learning to take place.
Teacher 5	I try to use new and interesting methods to teach my content area, not only for the students' sake but for my own as well. I am constantly adapting and changing lessons and trying new lessons with the hopes of finding new ways to getting kids to learn and to inspire them. I feel it is my responsibility as a teacher to keep up with new innovations to provide the most up-to-date methods of instruction and tools of my field.
Teacher 7	If I don't try it, I am doing a disservice to the kids. There might be better ways of doing things. I have to see if there is a better way, if it works for them and for me. Kids need to have the benefits of what might work better.
Teacher 8	I'm not afraid of change. I like to try new things and get excited about new ideas…

It seems these teachers place the needs of their students first and in doing so often need to make changes in their lesson plans to accommodate student needs. At times, this requires taking risks that things may not work out well. It requires "tolerance for anxiety and moving out of the "comfort zone", as Teacher 4 put it. Teacher 11 echoed similar feelings when she said, "I always have to challenge myself to get out of the comfort zone, and trying new things doesn't always feel comfortable." Several teachers made reference to teachers they knew who never changed lesson plans and have used the same ones for over twenty years. As the quotations reflected in Table 4.7, teachers in this study made a connection between the need to change and try new things to enhance student learning.

There was unanimous agreement that change and trying new things to find better ways is a positive thing as reflected in Table 4.8:

Table 4.8
Teachers' Attitudes Towards Change

Teacher 1	I am very open to change. Early on, I stuck to formulas when I was less familiar, as I get older, change comes easier and I can alter formulas.
Teacher 3	You learn from changes. I'm always trying new things. As an artist I am a risk taker, always stretching out of the mold. It's important to develop creativity. I encourage my students: don't fear trying.
Teacher 4	Change energizes and challenges me. It eliminates the possibility of ending up in a rut.
Teacher 5	Someone once said that the only thing that is constant in life is change. I view changes in education (and elsewhere) as exciting new opportunities to learn new ways of doing things and new ways of teaching.
Teacher 8	I like new ways of doing things, keeps me stimulated and interested, keeps my students stimulated and interested.
Teacher 10	Change due to better practices and more efficient use of resources (i.e. innovations) is common sense prudency.

Connected to the need and willingness to change is teachers' desires to improve their craft, which is part of who they are personally. When teachers talked about the need to improve they often talked about sharing what they have learned with others. I sensed a feeling of collegiality. For example, Teacher 3 and 4 knew what each was doing in their classes. Teacher 8, 9 and 10 were familiar with each other's work as evidenced in their conversations with me during the interviews. While I was interviewing Teacher 1,we were interrupted by another teacher who needed some help with some technical equipment. From their conversation, I could surmise that they shared ideas and supported one another.

The corollary to this positive attitude towards change and innovation was a consensus of feeling that change just for sake of change is not a good thing. Over time experience in teaching has involved these teachers in living through many innovations

that gained favor then subsequently fell out of favor. The prevailing feeling seemed to be that one must still try new things, but it must make sense with what one feels is beneficial to the teacher and students. As Teacher 2 put it, "you need to reflect on change and innovation based on your beliefs and attitudes…you need to keep improving, growing, but you have to understand why you are changing, look at the rationale to see if it fits or doesn't fit with your beliefs, attitudes or practice." My impression was that teachers in this study were reflective thinkers and were not going to change because something new was presented to them. They were going to evaluate innovations and change their practices if they believed students would benefit.

Summary of Self-Beliefs

In analyzing each of the sub-themes that comprised the personal characteristics of teachers in the personal domain, I looked for variability along a continuum for all teachers for each characteristic. In examining *caring and compassion* along a continuum, teachers in this study were on the high end of the continuum with very little variability demonstrated among them. I found the same to be "true" for the characteristics *respect for students* and *openness to change*. However, on the continuum of the characteristic, *comfort and confidence*, there was one teacher that seemed more self-effacing than the others. Teacher 9 was, in my observation, more uncomfortable than the others with the term "exemplary technology-using teachers. " He disavowed the description of himself as "exemplary" several times and when asked "Would you invite me to a technology-based lesson that you feel would impress me as exemplary? (R.Q. 3.5) he said:

> Anytime. But remember, it will be me using someone else's technology package that is exemplary – not necessarily my original creation. This is what humbles me in this study of exemplary use in teaching – I seem to be good at using other peoples' ideas.

Also, one of his self-ascriptions was "old classroom grunt", which said a great deal to me.

In conclusion, teachers' self-beliefs, in my estimation, may be characterized as learner-centered in that teachers put students' learning ahead of their own needs to control, manage, and dispense knowledge they may have deemed valuable in ways that suited their comfort level. In the next section, teachers' beliefs about how students learn are discussed.

Beliefs About Learning

Responses to Research Question #1 (*What are the beliefs and attitudes of exemplary technology-using teachers with respect a) to the teaching and learning process*?) revealed similarities among the teachers in this study regardless of grade level or subject matter. The major overriding theme about how students learn can be characterized by learner-centeredness. McCombs and Whisler (1998, p. 9) define learner-centered as:

> The perspective that couples a focus on individual learners (their heredity, experiences, perspectives, backgrounds, talents, interests, capacities, and needs) with a focus on learning (the best available knowledge about learning and how it occurs and about teaching practices that are most effective in promoting the highest levels of motivation, learning, and achievement for all learners). This dual focus, then informs and drives educational decision making.

The sub-themes connected to the larger theme of learner-centeredness focused on a recognition that: students have diverse learning styles which must be taken into

consideration in planning for instruction; the teacher's role is that of a facilitator or coach, not the expert dispenser of knowledge; learning is an active process and requires students' interaction; student interests must be taken into consideration for learning to be positively impacted; and learning is a collaborative process where teachers and students share in the knowledge building process. Each sub-theme is explored in greater detail below.

Diverse Student Learning Styles. Teachers seemed to share the belief that students possess many different learning styles and it is their job to incorporate many teaching methods to accommodate students. For example, Teachers 1, 2 and 4 said they used Gardner's Multiple Intelligences theory to guide their teaching practices. During a conversation with Teacher 1, he showed me websites that he liked that expressed some of his beliefs about multimedia and the appropriate uses of technology. I saw direct references to Howard Gardner's vision of the classrooms of the future where students would create multimedia exhibits to demonstrate their understanding of different curricular topics. In this vision, "Show what you know" is seen as a methodology for students to create a variety of multimedia to demonstrate understanding. Students can use a variety of formats that express their learning styles.

A common statement was that all students have the capacity to learn and students learn in many different ways through different modalities. In Teacher 7's classroom a banner is prominently placed saying: "*No one can do everything, but everyone can do something*." Acknowledgment of different learning styles was explicitly stated in interviews:

Table 4.9
Teachers' Beliefs about Diverse Learning Styles

Teacher 1	Sensory register is different for different learners. We must respect differences in students' abilities, help students learn in their own best channels, help them with their own best ways of learning. I believe in Multiple Intelligences, that learners have different learning styles through different modalities.
Teacher 2	Students are multi-modal and learn in different ways. I use many modalities in my teaching, e.g. songs, dance…
Teacher 3	I am learner-centered and believe that students learn in different ways and have many learning styles.
Teacher 4	Not all students learn in the same way. Many different learning styles exist and one is not superior to another. Teachers must be sensitive to this fact!
Teacher 6	I believe that every student learns in different ways. Some pick up on information easily and others take longer to catch on. Some learners learn visually (having to see it done). Others learn by doing it themselves. Some students are auditory learners and learn through song and repetition. Others learn through practice. I like to vary my approaches to learning so as to reach all students.
Teacher 7	Students learn in different ways. My job is to find ways they learn best, find ways to get to them….there are visual, auditory learners, etc. I try to provide the diversity to accommodate different modalities.

Furthermore**,** from my observations, each classroom had multiple activity centers and students did not always work at the exactly the same thing at the same time. For example, in Teacher 3's class, students chose the art project they were going to develop and not any of the students' work looked alike. In some of the projects that students in Teacher 4's class were involved with, multiple types of activities were represented i.e. researching on the Internet, using Inspiration to illustrate information they found, a field trip, and an oral presentation.

Finally, the district belief and/or goal statements supported the value of recognizing diverse learning styles:

Table 4.10
District Belief and Goal Statements on Diverse Learning Styles

District A	District A will provide a curricula based on mastery of basic skills, but designed to challenge students to think, solve problems, and apply their skills/knowledge at high levels; the curricula will promote life long learning, meet individual needs, and provide equal access to all learners. (District Goals)
District B	By providing a challenging curriculum that fulfills students' individual needs, interests and abilities, it is the mission of the dedicated staff and involved community of the students to develop the academic and social skills necessary to achieve their potential and to function effectively as citizens in the changing society. (Elementary School Mission Statements)
District C	Students have diverse needs. (District Belief Statement)
District D	Every individual has a unique combination of abilities and attributes that when recognized, nurtured and challenged promote the realization of potential. (Belief Statement)

Active Learning. Every teacher expressed that students learn best by being actively involved in the learning process. Teachers agreed that learning by doing, no matter how old the student, was the best way to learn. Teachers seemed to share the belief that emphasis should be placed on application of knowledge, not just simply accumulation of knowledge. Thus, when teachers talked about their recognition of different learning styles and the importance of active, hands-on learning, there is some evidence of a constructivist approach to learning, which is connected to the belief that students learn in many different ways based on their experiences. However, no teacher explicitly stated they held "constructivist" beliefs. The following table provides some teachers' quotes that emphasize their belief about the importance of active, hands-on learning:

Table 4.11
Teachers' Beliefs about Active Learning

Teacher 2	Children learn mostly interactively. I believe lessons should require students to be actively involved in learning.
Teacher 4	Active student involvement is necessary in learning. The hands-on approach is always best.
Teacher 5	My beliefs about learning are that all students have the capacity to learn. I also believe that students learn best when they are actively involved in the process.
Teacher 8	I am a hands-on, practical kind of teacher. How I think students learn best is influenced by how I learn best – interactive, active, hands-on.
Teacher 9	Learning by doing DOES seem to work for most people.

Moreover, interactivity was very much a large part of each lesson that I observed. Teacher 1 had students work with a partner on a research project, searching information on the Internet, Teacher 8 had students work in small groups searching information on famous people in history (written on board) using their laptops, and Teacher 5 played a jeopardy game to review for a physics test where students were paired up to collaborate on answers. Teacher 11 had students working on an interactive web site and permitted students to work together if they wished. No observation involved teachers lecturing to students who passively listened.

After interviewing teachers and analyzing data having to do with teachers' beliefs about how children learn, I followed up with three teachers and explicitly asked them to define learning. The intent behind asking this question was to obtain a better understanding of how teachers thought learners learn. The answers to that question are in the following table:

Table 4.12
4.12 *Teachers' Definitions of Learning Support Active Learning*

Teacher 1	In my mind, learning is adding to or building upon existing knowledge incrementally and exponentially. It depends on the situation, the individual, and the conditions within which learning is taking place. Learning is, in essence, change and therefore behaves as change behaves. We can learn in a very purposeful manner with planning, design, assessment, more planning, more design, more assessment, etc. On the other hand, learning can happen almost spontaneously either from catastrophe or radical change in conditions. In addition to relying on our store of knowledge, our intuition is called into play to invent or create solutions to problems we have never faced before.
Teacher 4	I look upon learning as a process….The process usually involves several steps, all of which involve the learner! Writing down the new information, repeating it, trying it out, reflecting on mistakes, incorporating feedback…If the process of learning is to be successful, there must be some kind of purposeful interaction between content and the students. Additionally, the best learning occurs when new information is connected to prior knowledge.
Teacher 5	From my point of view, learning means being able to apply concepts and information in a new setting. I know that there are many levels of learning, ones that just include students recalling information. In my experience, real lifelong learning occurs when students can take information and do something with it. Not just recite it or repeat it, but taking the information and using it to build something or critique something or analyze something.

From these definitions, I could see that an important aspect to learning is connecting new information to existing information in the learners' knowledge base. It made sense that teachers focused on students' diverse learning needs (discussed earlier). It seemed to explain why many teachers believed that it was important to relate content to students' interests because it was motivating and relevant to their worlds and thus would stimulate meaningful learning (discussed more fully in a subsequent section). Another reason might be that teachers believed in a psychological basis of learning accumulated through research in cognitive science. I saw connections to Jones et al. (1994) indicator 4, of the Indicators of Engaged Learning (Appendix I) and the APA Effective Learning

Principle 1 (APA & McREL, 1993) (Appendix L). Both sources represent a distillation of current research on effective learning.

Although only three teachers were asked their definitions of learning directly, similar thoughts by the other teachers were expressed in conjunction with other interview questions. From all the teachers' perspectives what learning is NOT is the acquisition of facts and concepts. Application of knowledge, active involvement in the process of application of new knowledge and the building of new knowledge building on existing knowledge reflect teachers' beliefs about learning more accurately.

Teacher as Facilitator. A common belief shared by teachers is that students not only learn from them as the "expert" in the class, but from each other as well. Teachers shared the belief that their role is that of a facilitator rather than the "sage on the stage" (Reigeluth, 1999, p. 19). Learner-centered beliefs were expressed quite explicitly. Teachers consistently said that learners are active participants in the learning process and that the teacher's role was more of a facilitator to guide students through the process acknowledging and accommodating different learning styles. Teachers felt it was their job to find ways to accommodate different learning styles so that all students could be successful. This belief seems to be connected to the belief that all children can learn. Furthermore, in teachers' descriptions of how children learn, a shared belief heard often is that learning is enhanced if students are engaged in discovering relationships and building their own knowledge bases rather than having the teacher give them the answers or provide the definitive knowledge representation. Peer learning and collaborative

activities were some manifestations of the belief that students learn from each other. The following quotes from Teachers 7 and 11 expressed these beliefs in Table 4.13:

Table 4.13
Teachers' Beliefs about Facilitator Role in Peer Learning

Teacher 7	I like collaborative learning and kids teaching other kids, I put certain students with students so they can learn from them – peer teaching goes on and it makes my job easier because I can't do it all.
Teacher 11	Inquiry-based learning is what I believe in, like kids to explore learning without me giving them the information. I want them to explore. In A/P class, I use the Socratic method, letting them determine the topics for discussion. I am the facilitator and I will guide them. I am there to provide the tools for students to help them find the answers…do a lot of group work – other students are resources, but ultimately they are responsible for their own learning.

Teacher 4, 10 and 11 were more explicit and said they were facilitators in the learning process. Teacher 4 said, "I learn much from my students!" In an observation of Teacher 11, the class worked either independently or in groups if they chose. She circulated to help students as needed.

Moreover, from the physical arrangements in every classroom I observed, not one of the classrooms had students seated in rows facing the front with the teachers' desks taking center stage. This indicated to me that teachers were viewing their roles in non-traditional ways where they were not the focus of students' attention. Students were seated in groupings of 4-5 students per group with teachers' desks off to one side of the room, not prominently placed in the classroom. Teacher 7's classroom did have three long rows of 7-8-7 students per row, however, students' desks did not face the teacher's desk. The physical arrangements of the classrooms I observed suggested flexibility for grouping students to encourage students working with peers as well as the teacher.

Student Interests Taken Into Account. Another learner-centered belief often repeated was that it is very important to engage students in topics and projects that can be related to their own lives and experiences. Teacher 8 said he planned activities and lessons with students' interests in mind, making sure that they were challenging and stimulating enough to get students motivated and excited about learning. In the observation of Teacher 8, I could see how he related his lesson content to students' lives so they could make connections to something relevant to them and this was accomplished through asking students questions that related their experiences to the lesson being taught.

Teacher 4 said, "authentic settings/problems provide the best environment for learning. There is no substitute for relevancy." Teacher 5 talked about his passion for teaching and his excitement about his subject area, science. He wanted to inspire his students to feel that excitement about science as well and sought new and interesting methods "with the hopes of finding new ways of getting kids to learn." Teacher 9 was motivated to be sensitive to students' needs because of his experience with teachers when he was in school. He had discovered some of his teachers did not have a good command of their subject matter. He said: "some of the people I had in public school would never survive the scrutiny of today. I don't want any of my students feeling that way about me – maybe that's what motivated me to be sensitive to students needs over the years."

Moreover, it seemed that teachers thought it was important to get to know students beyond the classroom walls and find out what is important and relevant to them in their lives. Teacher 11, for example, used this information to incorporate things from popular culture that students were very familiar with into her lessons. She believed that

this made her lessons more motivating to her students and more interesting (relatable) to them. She talked about how she taught her English class the concept of "illusion" and used the cartoon characters of the Simpson's to illustrate the concept.

Students' interests are taken into account by establishing am ore personal relationship with them. Teacher 11 said she brought a lot of herself into the classroom making her seem more human-like and approachable. She told students how she felt at their age and often revealed some of her personal experiences she had had. She felt it was very important to build a good relationship with students showing them that she cared about them and was interested in them and what interested them. Students may not like the subject matter content, she believed, but they could still take away a positive learning experience that colors learning in general.

In a discussion with Teacher 6, she showed me a project that her students were doing on monarch butterflies. She said how much the children enjoyed doing the unit at the beginning of the school year. The project was set up in one corner of the room beside a window and students loved to watch the progress of a caterpillar's life cycle that culminated in the evolution into butterflies. Students would do "much research on the Internet, on Knowledge Box and United Streaming to find more information about them." Students later released the butterflies outside. The children do a similar project on chicks that the teacher brings in from her farm. "Finding information and watching presentations about what is going to happen as those chicks grow inside the eggs gets my students excited in anticipation of hatching day." Teacher 6 used age-appropriate (Grade 1) lessons and projects to interest her students in discovering things about nature around them. In an observation of Teacher 6, she used streaming video for a lesson on the

alphabet. Students seemed fascinated with the videos showing picture vocabulary for each letter of the alphabet. They learned about animals and nature at the same time. At this grade level, students were very curious about some of the video clips especially of things they had never encountered before. Teacher 6 used the opportunity to stop the video and explain what they were looking at. In general, the lesson was informative and stimulated the natural curiosity of the students because the content of the video clips captured their attention and interest.

Collaborative Learning. A belief already expressed above was that students learn from each other, not just from the teacher-expert. Teacher 7 said she likes collaborative learning and kids teaching other kids. She said she grouped kids based on how she thought students might learn from their peers. In the observation with Teacher 1, part of his lesson after the introduction of spreadsheets to his class was to have them do an activity in groups creating a spreadsheet laying out information about each person in their group. Students worked at five different work areas surrounding a computer. The physical arrangements of each classroom were such that teachers could conveniently arrange students in small groups to work either independently or collaboratively on in-class assignments. Teachers in every class observed except the grade 1 class (the teacher seemed to control the whole-class activity) encouraged students' interactions with each other exhibiting a greater tolerance for more noise; but it seemed to me that students remained on-task. Teachers talked about the importance of interaction as a component in active learning as discussed above, however, this interaction is not only with instructional materials but also with others in the learning environment – teachers and students alike.

Thus, it was not surprising to hear teachers talk about the value of group activities or to see in observations group work in action. Collaborative learning is recognized by the APA & McREL (1993) as one of their learner-centered principles.

In an observation of Teacher 8, part of the lesson required students to work in groups to research information on historical figures. At the end of the lesson, students gathered together to discuss their findings in a large group discussion format. The district curriculum for this class stated that the instructor should employ a variety of teaching methods that includes cooperative learning, experiential/inquiry learning and lecture/discussion among other methods. In this class I observed several of these methods being employed including collaborative group work.

Teacher 11 had students working on an Internet-based project in small groups, however, some students worked independently if they wished. Students, whether in a group or not, were permitted to talk with one another about their project work.

From a review of district documents, it was also apparent that the district supported the value of collaboration:

Table 4.14
District Support of Collaborative Learning

District A	…are committed to the use of all available resources to provide quality instructional programs through which all students will develop their greatest potential, demonstrate mutual respect, work cooperatively to achieve clearly stated goals… (Technology Mission Statement) The Assessment Plan includes: portfolios, journals, writing assessments, performance-based assessment, classroom participation, community service… (District Strategic Plan)
District B	The sharing of ideas promotes personal and group growth. (Belief Statement)
District C	..are committed to the use of all available resources to provide quality instructional programs through which all students will develop their greatest potential, demonstrate mutual respect; work cooperatively, value the learning process… (Elementary Principal Statement on Web site)
District D	LEARNING INDEPENDENTLY AND COLLABORATIVELY: Public schools should encourage students to become independent life-long learners and to collaborate with others in developing knowledge, skills and new ideas. (District Goals Statement)

Finally, in District D's High School newsletter, there was a news item about grade 10 students who were required to enroll in a research class in one of the terms during the year. Students choose topics of interest to them as well as the community, school, and/or peers and work collaboratively researching their topics using available resources provided by the school. The project culminates in the writing of research papers followed by the creation and presentation of an iMovie made available to the public, other schools and students to view. Another news item reported on school groups working on community projects e.g., The Health Team was working in conjunction with The Caring Team raising money for The Caring Foundation for Children, a program that seeks to identify uninsured children for enrollment in free comprehensive healthcare benefits. Other groups worked together to help promote a local Center for the Arts, some worked together on school events to raise money for local food banks and create community awareness of the local and regional hunger problem. The value of

collaborative learning, thus, is expressed in classroom, school and community activities as well.

In the section on how beliefs and attitudes affect instructional practices, there will be more discussion of how this particular sub-theme plays out in practice – the practices that teachers say they do, and the practices observed in the scheduled observations.

Summary of Beliefs about Learning

When I analyzed the sub-themes of d*iverse student learning styles*, a*ctive learning,* and s*tudent interests taken into account*, I found little variability among the teachers' beliefs about learning with respect to these variables. They all seemed to converge on the high side of the continuum for each sub-theme irrespective of type, age, or level of learner. However, in the sub-themes of *teacher as facilitator* and *collaborative learning*, I did see a variation with Teacher 6. In the observation of her class, I saw more teacher directedness and structure to her lesson. However, this made sense to me because first of all, she taught grade 1, and her students were just beginning the school year. At this point in time, taking into consideration the maturity level of the students, I expected to see more direction and structure than with older students. Teacher 6 did say in her interview that for teaching basic math or reading skills she used more traditional approaches and that

> An average lesson in math or reading does not involve the use of technology. There are still the basic skills that need to be taught in math and reading and we need books and manipulatives to do this. Although we do certain parts with the use of technology, we always go back to the basics.

With respect to collaborative learning, this teacher had students work on projects, however, most were whole-class projects, not small group projects e.g. the monarch butterfly project.

Cultural/Environmental Domain

Research question #2 asked: *What has influenced the development of the beliefs and attitudes of exemplary technology-using teachers?* Three sub-questions asked teachers to describe influences from their past: early learning experiences, teacher education experiences, and memorable teachers. A fourth question asked about teachers' present learning contexts in order to explore present influences. The final question in that grouping about influences on the development of teachers' beliefs and attitudes asked when teachers began to see a relationship between teaching, learning and technology. (Research Question #2.5). How teachers responded to that question overlapped considerably with the conversation about instructional practices, therefore, this issue will be explored in greater detail in the section, The Pedagogical Domain. In the next two sections teachers' early learning influences and their present supportive, resource-rich learning environments are explored.

Early Learning Environments

My initial belief was that a consistent pattern might emerge that indicated teachers had similar positive early school experiences that may have inspired them to choose teaching as a career. However, that was not the case. Positive and negative experiences

at different times during teachers' lives as students characterized their collective experiences.

Overall, teachers had a positive attitude towards school in general. Many teachers expressed that they really liked school even though some had a few negative experiences, which provided them with examples of what not to do in their own teaching:

Table 4.15
Early Learning Environments

Teacher 1	I was frustrated with school, was not an academic. School was an oppressive environment, lots of lecturing, rote learning. I was in a small school, rural setting, 2 grades in one room. One teacher did try to break out of rote learning and I remember those lessons the most.
Teacher 2	I went to school in the same district that I teach in now. It was a very positive learning environment, supportive, good teachers, strong role models. I felt I could learn. I built confidence in my learning capabilities. Teachers valued me and cared about me, knew me well and encouraged me to continue in education.
Teacher 7	I wanted to be like my 5th grade teacher. She was instrumental in my wanting to teach. I was a good academic student…school was a great experience for me and I want the same for my students. I want them to want to be here and enjoy themselves. I had a HS math teacher that taught through fear, intimidation and humiliation. I knew that is not how I wanted to teach.
Teacher 8	I was a very involved student – socially very active in school and I was on many sports teams, band…not a great academic student. But, school was my life, a great experience. I learned I wanted to be a teacher because of my sixth grade teachers. They were great, made learning interesting, motivating. I like the way they taught, they taught collaboratively, they team-taught. They made us think.
Teacher 10	My early experiences were very positive because I was put into situations in which I was successful, and my teachers cared about me and my learning, and created an environment in which I was comfortable.
Teacher 11	I always enjoyed school, I did what had to be done to get acceptable grades for parents' sake, was shy, went along with the program. I found teachers didn't make subjects interesting and motivating. I like learning. I read a lot, had a good memory, but high school was not challenging, sat in lectures and was bored.

Thus, positive and negative experiences influenced how teachers taught, however, whether positive or negative, all teachers were not discouraged from teaching, and conversations with every teacher left me with an impression that they were very enthusiastic and excited about teaching even those teachers who had been teaching for many years. The *desire to teach* was not diminished by negative experiences.

It seemed to me that beliefs about what constitutes some examples of good teaching practices were predicated on teachers' evaluations of what were good and bad examples early in their educational experiences. For example, Teacher 3 talked about how bored she was in elementary through grade 8. Little hands-on work with much lecturing and rote learning characterized her early experiences. In my observation of her art class, I saw that she had her students working more collaboratively and noticed how engaged students looked during her class. Students were permitted to move about freely if they wanted to see what other students were creating.

The excitement about learning had worn off by high school for Teacher 11. She described her high school experiences as "mind-numbing", several others called their experiences frustrating, non-stimulating and de-motivating. Teacher 7 vowed she would never teach as she was taught in one of her high school math classes. She said that this teacher taught through fear, intimidation, and humiliation. As a result of particular negative experience, she realized early on the importance of respect, caring, and compassion in teaching. Teacher 9 had the following to say about his experience with teachers (nuns) that he felt were more concerned with managing and controlling students:

> As I grew older, I started to realize that I developed a genuine respect for those teachers who sort of earned that respect rather than demanded it. Some of the people I had in public school would never survive the scrutiny of today. I don't

> want any of my students feeling that way about me – maybe that's what has motivated me to be sensitive to students' needs over the years.

The positive aspects of early learning experiences coalesced around descriptions of environments that were challenging, stimulating and motivating. The good role models that many teachers talked about characterized good teachers as interested in and enthusiastic about their subject matter, with a caring, respectful and genuine interest in their students. In the positive experiences, teachers had felt that as students they were valued and encouraged to pursue learning. Positive learning environments were comfortable and nurturing ones that supported students. In the following table teachers characterize some of their learning environments:

Table 4.16
Positive Learning Environments

Teacher 2	…it was supportive, good teachers, strong role models that I felt I could learn from, I built confidence in my learning capabilities. Teachers valued me and cared about me, knew me well, encouraged me to continue in education.
Teacher 4	Had many good teachers who gave me tools, they did not make it easy, they all provided challenge which I thrived on – they all worked to help me achieve.
Teacher 10	My early experiences were very positive because I was put into situations in which I was successful, and my teachers cared about me and my learning, and created an environment in which I was comfortable.

When teachers were asked about memorable teachers in their early learning experiences (Research Question #2.3), many of the positive characteristics talked about above were echoed:

Table 4.17
Positive Teacher Role Models

Teacher 1	One teacher did try to break out of the rote learning approach, it was in art & music. I remember those classes the most.
Teacher 4	There were many of them and they had a profound effect. I remember 12th grade Advanced Composition and Speech – had writing every week. I excelled, developed good work habits, and had a very supportive environment – this teacher pushed us to a high bar that was attainable. She was tough but fair – she brought the real world into the class, gave great feedback…set the tone for positive learning in the future.
Teacher 5	Liked challenge so I liked all the hard teachers, respected my geometry teacher, did group work there in a problem-solving environment…I was motivated and self-driven in that kind of environment.
Teacher 8	I liked my 6th grade teachers. Learned then that I wanted to be a teacher. All my 6th grade teachers were great, made learning interesting, motivating. I liked the way they taught…collaboratively, team-taught, they made us think.
Teacher 11	I had a few memorable teachers in high school and grad school. In grad school, teachers took an interest in me. I was shy, quiet, and could be overlooked very easily. I didn't stand out. Teachers praised me, were enthusiastic in their subject area, made you feel that if they liked it so much it's got to be good. Some teachers in high school were not condescending, I wasn't made to feel like a child.

Ultimately, teachers wanted to treat their students as they had been treated by teachers they considered to be good role models.

With respect to teacher education experiences, there were positive and negative experiences as well as the quotes in the next table indicate:

Table 4.18
Teacher Education Experiences

Teacher 1	I came to teacher education later. In my student teaching experience, I had no cooperating teacher. She left after a couple of days, so I got no mentoring, but it worked out well because I got lots of guidance from my university supervisor.
Teacher 4	My teacher education experience was a very good experience. I had good models and mentors for teaching, very encouraging environment, very small college, very nurturing, positive experiences in student internships, good cooperating teachers.
Teacher 5	I was never observed during training, kind of fell through the cracks. I was given no feedback. No one helped me. I was floundering, had no pedagogical knowledge. I would have developed quicker if guided – got most of my training on the job – a baptism by fire. Now I give a lot to students that I supervise.
Teacher 8	Teacher education was a waste of time, a joke. I really learned to teach the first couple of year of actually teaching. Teacher education did not have enough actual teaching experience, I could not see any relevance.
Teacher 11	There were smaller classes and I had a good relationship with teachers, became friends with teachers because I was older when I went back for teacher training. I learned a lot that did apply to what I do today.

In conclusion, five teachers (1, 5, 7, 8, 9) explicitly expressed that most of their teaching expertise came from on-the-job experiences, which speaks to the importance of a supportive and resource-rich environment to help fill the gaps in teacher preparation. The other teachers had valuable teacher education experiences, however, all teachers stressed the importance of on-going supportive professional development in their learning contexts, which is explored in greater detail in the next section.

Summary of Early Learning Environments

Overall, I was impressed with teachers' desire to learn and teach and saw little variability among teachers in this study on this sub-theme. Through conversations with teachers, classroom observations, and observations of teachers "off-the-clock", I could see that they genuinely liked what they were doing in their roles as teachers. However, on the positive and negative early experiences, there was much variability with an almost

split in numbers of teachers with a preponderance of positive early learning experiences and those with a preponderance of negative early learning experiences. The common point was that these influences did have an impact and resulted in teachers' deciding to emulate what they felt were good examples of teaching and learning, or to do the opposite of the examples they felt were poor models of teaching and learning.

Supportive and Resource-Rich Learning Environments

All school districts in this study provided technology-rich contexts for teachers. In chapter 3, table 3-1 summarized technical resources available in the classrooms observed in each school district. School district D is a 'digital school district', which meant that high quality technology has been federally funded providing access to not only the schools in the district but the community as well. District A integrates technology in everything they do according to the district school district web site:

> With a high-speed fiber network newly installed by TCI connecting every building in the district, faculty and students are utilizing voice, data, and full-motion video in their every day learning and business activities. Three satellite dishes also make distance learning available via the fiber at all sites.

District A's Curriculum goals also refer to their commitment to promote continued professional development for instructional and support staff as well as provide educational opportunities for community members.

School districts B and C have superintendents and technical coordinators who have sought grants to support technology acquisition. District B has a foundation whose mission is to assist the district with funding to provide for "technological innovation and to reward students and teachers for both education achievement and excellence." Some

grant initiatives listed in this district's brochure include: E-Rate, TLCF (Technology Literacy Challenge Fund), CSR (Class Size Reduction), Title I, II and VI and DCED (Digital Divide).

All districts invest tremendous efforts in professional development in technology integration as well. Workshops are offered year round as evidenced by the offerings listed on each district web site. As Teachers 2, 4, 5 (District B) and Teacher10 (District D) mentioned, so much is offered by the district at multiple times of the year, there is no excuse for a teacher not to take advantage of improving their technology and teaching skills. District B offers summer workshops in which Teachers 4 and 6 help conduct. Teachers are encouraged to be leaders and mentors for their peers. District C offers summer workshops in addition to year round in-service training, not only for teachers, but also for interested community members at little or no cost. In District D, professional development time is built into each day for all staff, allowing them to participate in direct instruction opportunities or to network with other staff members within the building or district. It is not unusual to see teachers mentoring each other before, during, and after school according to Teacher 10 from school district D. Because staff is equipped with wireless connections, training can take place anytime, anywhere in the district.

Evidence from each district technology plan or technology mission goals, indicate a commitment to provide the necessary resources to implement current and emerging technology. This was evident in each school and classroom visited. In the following table, district technology mission statements, belief statements or district goals as expressed by district superintendents point to this commitment:

Table 4.19
District Mission and Belief Statements

District	Technology Mission/Plan
A	Technology Mission Statement: We believe that people are empowered by their independent use of computers and other technologies and united by their opportunities to share resources and communicate in a global community." The District is committed to the use of all available resources to provide quality instructional programs through which all students will develop their greatest potential, demonstrate mutual respect, work cooperatively to achieve clearly stated goals, value the learning process and prepare-in a safe and orderly environment-for a productive role in a democratic society.
B	Beliefs Statement # (7): Provide equipment and training so students and staff will be technologically competent.
C	School District Education Foundation Mission: Develop an entity that can assist the school district with funding to provide for technological innovation and to reward students and teachers for both educational achievement and excellence. Superintendent's Statement: "We are striving to provide our students and community with the most advances and appropriate technology possible."
D	Superintendent's Message: In 2001, as the winner of a statewide competition, the district was designated a Pennsylvania Digital School District. It is a part of a pioneering multi-million dollar initiative by the Pennsylvania Department of Education to create a model of education that illustrates how the information revolution can be harnessed to create a digital education revolution.

Furthermore, support in the way of technical assistance for both technology and pedagogical implementation is provided. For example, District B has "technical integrators" whose job it is to help teachers with not only the technical aspects of integrating technology, but also the pedagogical aspects. The vast availability of software tools used by all four school district is further evidence of a commitment to enhance the learning experience of all students.

From the teachers' perspectives, they felt very supported by technology resources and felt supported in trying new approaches in the classroom. Overwhelmingly, technology integration was encouraged and supported in many ways through access to technology in each classroom, professional development opportunities, and support

services to use technology effectively. Teacher 5 talked about his sophisticated "clientele" and how technologically advanced his school district was. In this environment, he talked about the need to keep on his toes. Teachers also talked about working in an atmosphere of sharing ideas and technical/pedagogical expertise. This indicated evidence of teacher collegiality. Teachers 4 and 5 worked with other teachers during the summer to help them develop technology and pedagogical skills. Teacher 10 talked about how teachers freely exchanged ideas with one another either face-to-face or via wireless laptop computers. I also came to the conclusion that teachers shared ideas from Teachers 2,3,4,5 9, and 10, when in conversations with them, they talked about what other teachers in their school districts were doing. They seemed to get ideas from one another. When Teacher 5 developed his jeopardy game, he planned to share this with his district teachers. Many teachers talked about collaborative efforts with peers and that this free exchange was often extended to students as well because all teachers interviewed held the belief that peer learning is valuable and that learning about technology through students, for example, did not reflect negatively upon them. Teacher 3 said she awarded "smart points" to students who came up with good ideas. She regarded her students and herself as partners in learning. Students were encouraged to contribute and be creative in her class. The following quotes taken from teacher interviews provide evidence of a supportive learning environment:

Table 4.20
Supportive Learning Environments

Teacher 2	There is a lot of professional training and development as teachers for skills in technology and pedagogy, every possible resource is made available. In-service has a good balance of technical skills and developing pedagogical skills like performance based assessment, rubrics. There is a lot of sharing of ideas with other teachers, lots of enthusiasm and excitement about trying new things and sharing what works.
Teacher 4	It feels like a family, everyone is supportive, the principal, tech coordinator and tech integrators provide excellent ideas for implementing technology in the classroom and they help you do it. Summer training is offered and I help with training. Teachers are so appreciative to have hands-on help, there is excitement and enthusiasm to try new things.
Teacher 7	The school supports technology and I like technology, so this works for us.
Teacher 8	We have great teachers, great staff, and a supportive administration.
Teacher 11	We're a digital school district, so we are technology rich and it is emphasized. Every child has a laptop. Support for technology and professional development is strong. Technicians fix problems quickly.

In addition, there was a recognition that the learning context extended beyond the classroom, school building, and school district. All school districts recognized the importance of community involvement and support. The prevailing feeling was that parents and community should be connected. For example, school district curricula, school events, news announcements, sports information along with a wealth of other information are published on the districts' websites. In district mission and beliefs statements, it is clear that districts value community involvement.

District A shares a fiber network that provides affordable on-line access to the schools and the Internet. Community membership exceeds 800 and parents and community members are connected to give them opportunities to work with the school district on mutual goals. District C has a goal of increasing community and public involvement and to that end is increasing Internet access to the community and providing technology classes for the community. In addition, communication between school and

home is facilitated by access to teachers' and administrators' email or voice mailboxes in all districts. District D has a homework hotline so that parents and students are able to access information regarding upcoming tests, homework, assignments and other information pertinent to classroom instruction. In one school building in District D, students publish an electronic literature magazine. This "e-Lit" provided a forum for middle school students to publish poems, short stories and essays for a wider audience. In many schools, teachers showcased some of students' work on their own websites linked from the district websites.

In general, there seemed to be compatible connections among four aspects of the learning context: the learning environment supported by the district and expressed in their mission and/or belief statements; the classroom learning environments fostered by the teachers, the philosophies of education suggested by the mission, belief statements and educational goals of the school districts; and the beliefs teachers hold about how children learn along with how to best foster that learning. For example, District B's mission statement addresses the partnership of students, educators, parents, and community in helping "students develop skills, knowledge and talents to achieve their fullest potential and to become lifelong learners and productive, responsible citizens." Common district beliefs (published on websites) include: students needs are diverse, caring and responsible attitudes create respectful individuals, a caring staff is vital for success, sharing of ideas promotes personal and group growth, and everyone can learn and succeed. District A views the district with parents, students, and staff jointly accountable for their roles in assisting all learners to master high academic, social, emotional and physical outcomes. District D reiterated similar beliefs concerning

education as a partnership among family, school, and community, that respect for self and others promotes a sense of community and an environment conducive to learning, and that all people want to learn and can learn. Teachers in these school districts expressed similar beliefs and designed their classroom environments to embrace these beliefs.

Learner-centered beliefs are expressed in districts belief statements mission statements and/or district goals statements:

Table 4.21
Learner-Centered District Beliefs

District A	:…will provide a curricula based on mastery of basic skills, but designed to challenge students to think, solve problems, and apply their skill/knowledge at high levels; the curricula will promote life long learning, meet individual needs, and provide equal access to all learners. (District A District Goals) .. District and the community, in partnership, will successfully challenge learners to become world-class citizens, who will be responsible, contributing and ethical members of an ever changing global society. (Mission Statement)
District B	The student is the focus of education. Students have diverse needs. Everyone can learn and succeed. (Belief Statements)
District C	Distrtict C (Jr/Sr High School): It is the MISSION of our dedicated staff and involved community to create a positive climate in which ALL students will develop the academic, technological and social skills necessary to function successfully as citizens in our every-changing global society. District C (Elementary School): By providing a challenging and innovative curriculum that fulfills students' individual needs, interests and abilities, it is the mission of the dedicated staff and involved community of the student will develop the academic and social skills necessary to achieve their potential and to function effectively as citizens in the changing society.
District D	All people want to learn; all people can learn. Every individual has a unique combination of abilities and attributes that when recognized, nurtured and challenged promote the realization of potential. (Belief Statement)

Thus, teachers in this study found themselves in school districts where learner-centered beliefs were openly supported and were consistent with many of their own learner-centered beliefs.

Summary of Supportive and Resource-Rich Learning Environments

Teachers seemed to show little variability along the continuum of each sub-theme except for Teacher 7 in the sub-theme *collegiality.* Teacher 7 was very supported by her district administrators and was provided excellent technical support and access to technology-rich resources. Since she was very open to change and willing to try new innovations, the superintendent and principal provided her with the newest technology to try out in her classroom. This, apparently, created some dissatisfaction (professional jealousy?) among her fellow teachers who had previously shown resistance, but then felt slighted when they were not chosen to try new technologies in their classrooms. The situation was resolving itself at the time of this study however, I concluded that in her case, collegiality was not at the high end of the continuum as it had been for all the other teachers in this study.

In the next section, the influences of teachers' beliefs and attitudes on instructional practices are explored.

The Pedagogical Domain

Research Question #3 (*How have exemplary technology-using teachers' beliefs and attitudes affected their instructional practices?)* explored how teachers' beliefs and

attitudes influenced their instructional practices with an emphasis on how technology was integrated with instructional practices. In general, I saw a consistent pattern of learner-centered beliefs with learner-centered practices as expressed by teachers in their responses to the interview question #3.3 (*How has your teaching changed with respect to technology? For example, can your describe a typical lesson you would teach with technology – and one you might teach without technology to illustrate the difference?).* This consistency was demonstrated in instructional practices used during observations as well. The main sub-themes that surfaced were the level of pedagogical expertise exhibited by the teachers in this study and how technology was employed as a valuable tool/resource in the service of curricular goals.

Pedagogical Expertise

Nine of the eleven teachers in this study had more than ten years of teaching experience (Table 3-6). It was evident through the observations that these teachers were seasoned teachers who felt comfortable and confident in their teaching. I came to the conclusion that pedagogical expertise was an important component in their teaching with technology. In answering Research Question #3: *How have exemplary technology-using teachers' beliefs and attitudes affected their instructional practices?* teachers talked about how their beliefs about teaching and learning influence their use of technology. Teacher 1, 2, 4, 7, and 8 explicitly stated that technology use was incorporated with instructional strategies that suited the objectives of the lessons taught. The important idea that came across from teachers' conversations about technology use is that exemplary technology use has a great deal to do with how the technology is used

pedagogically. Instructional strategies do not necessarily change with technology. Sound pedagogy is what is important when using technology as a tool. Teacher 4 expressed this idea when she said:

> Technology is a tool, a resource to make teaching and learning more effective, but it must be used properly, pedagogically – so pedagogy is first, technology works in partnership with students. For example, using powerpoint by teachers can be overdone and it is teacher-centered, instead encourage interaction with students, have students use powerpoint. Don't teach with it all the time, make it more student-centered.

Expressing similar thoughts, Teacher 7 commented:

> Technology gives me more options; it's a great resource. My teaching hasn't changed. I have a respect for kids, a desire to help them. My personality in my teaching is who I am. Technology only helps me do what I do better and that is to help students. Technology is a motivator for kids, it provides alternative ways of learning things, helps with special needs kids. I use technology mostly in these areas to help meet diversified student needs. Computers don't do that job. My observations tell me from experience what to do to meet student needs.

When teacher 2 and 8 talked about how their beliefs about teaching and learning influenced their use of technology and vice versa (interview question #3.2: *How has your teaching changed with respect to technology*?), they answered, respectively, as follows:

> My lessons are interactive whether with or without technology. Technology helps with making lessons more interactive. Students work in groups with and without computers. Pedagogy and technology are important-that is the framework, using technology that is pedagogically sound and makes sense teaching wise.

> My teaching with technology hasn't changed much, same strategies, with or without technology. Technology is a different tool, powerful with more options…beliefs are the same, technology didn't change that, it just provided more options and variety to lessons.

Teacher 5, one of the younger teachers in the study, said he has always used technology: "Technology came first, then teaching." His beliefs about teaching and learning are that students actively learn and his choice of software reflects this:

> I use a hands-on approach so kids "do" physics; choice of software is simulations, visual software. In my subject area, it is necessary to use technology, like simulations… the inert knowledge problem is solved. There is a natural connection to content and technology. The technology use has to make sense. Need to think about how content suits the technology, you have to ask, does the technology serve needs of kids?

Although experience alone does not ensure expertise, based on teachers' conversations about the importance of good instructional strategies and analyses of lesson plans and student projects, pedagogical expertise seemed evident. Indicators of pedagogical expertise that guided my analysis were taken primarily from two sources containing similar variables: Means' Engaged Learning Variables (Appendix H) and Jones, et al. (1994) Meaningful, Engaged Learning Framework (Appendix I). In addition, since a major theme in this study is learner centeredness, I considered the learner centered learner-centered psychological principles (Appendix L) developed jointly by the American Psychological Association (APA) and the Mid-Continent Regional Educational Laboratory (McREL). These principles served as a lens through which I evaluated teachers' beliefs and instructional practices.

Indicator 4 (*Instructional Models & Strategies for Engaged Learning*) of the Meaningful, Engaged Learning Framework (Jones, et al., 1994) says the most powerful models of instruction are interactive. It was apparent that the teachers in this study believed in and encouraged student interactivity during the learning process. This indicator further states that instruction actively engages the learner and encourages the learner to construct and produce knowledge in meaningful ways. Teachers in this study agreed on the importance of having students actively engaged in the learning process and routinely gave students opportunities to produce knowledge in ways that demonstrated

their own understandings of what they learned from multiple sources. Evidence from student productions bore this out. For example, in Teacher 3's class, students created electronic portfolios of their artwork and wrote reflections about their artwork and growth as an artist. These reflections were successively built upon during students' three years of middle school.

Indicator 4 adds that students and teachers co-construct knowledge in problem-based or project-based activities. Collaborative problem-based or project-based learning were methods commonly used by the teachers in this study. For example, Teacher 4 talked about a project she has her students create on the Renaissance. She weaves technology into the lesson emphasizing interactivity. Students work in collaborative groups doing virtual tours on the web, doing background research about foods, clothing and habits of the time. Students used "Inspiration", a concept-mapping tool, to document their research. An extension of the project is a field trip to a local herb merchant. At a certain time of the year, the merchant and his employees dress up in the costumes of the Renaissance time. They serve foods of the time, talk about lute making, and etiquette. The final presentation consists of students' own choices about how they would showcase what they had learned about the Renaissance. It is evident that the tasks involved in this project were complex, sustained over a long period of time and blended in-class activities with community activities. Despite the fact that students were learning about past history, such activities lent a feeling of authenticity. Indicator 2 of the Meaningful, Engaged Learning Framework (Appendix I) speaks to the need to have challenging, authentic and multidisciplinary tasks that are complex and sustained over long periods of

time. This particular project also coincided with Means' Variables 1, 3, 4 and 7 (Appendix H)

Teacher 7 involves her students with group science projects and permits them choices as to what each group will research and report on. Students use the district's curriculum network (i.e. Knowledge Box) to do research. They can log onto multiple videos through the streaming video library or link to a vast number of suggested web sites. According to Teacher 7, students work collaboratively and autonomously, coinciding with Means' variable 4 and Jones et al. indicator 5.

The NETS for Teachers, III. states: *Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning.* A subordinate standard refers to using technology to support leaner-centered strategies that address the diverse needs of students. For example, Teacher 1 made an explicit reference to how technology helps him meet the diverse needs of his students:

> With technology, there is more front end work, but when kids understand, the computer becomes invisible. They are immersed in the work. Changes in my planning occur, but technology helps address a range of kids' abilities, so I need to diversify instruction – keep in mind the gifted kids, low ability readers, etc. I need to plan the use of technology to meet diverse student needs.

Teacher 7 makes the same observation about integrating technology into her teaching:

> Its all about student needs and identifying them better and figuring out what works best in each case – technology has enhanced my teaching because now I have more tools and resources on hand.

Teacher 8 echoes this same idea:

> Technology hasn't changed my teaching much – beliefs are the same, technology didn't change that, it provides more options and variety to lessons, keeps me open to new ways of doing things and keeps kids interested and motivated.

In the research literature, findings from other studies have revealed that exemplary technology-using teachers have more teaching experience (Becker, 1994), exhibit higher levels of pedagogical expertise, and focus on activities that are more student-centered (Becker, 1994; Hadley & Sheingold, 1993; Pierson, 2001; Swan & Mitrani, 1993). Although every observed lesson had a technology component to it, the pedagogical skill was evident. Teacher 8, for example, used knowledge of his students to inform his strategy of asking high-level cognitive questions that connected his lesson having to do with a past historical event to their current world events. Teacher 5 developed the jeopardy game for review, which allowed him to conduct mini-lessons between each question-answer set. Teacher 4 talked about how she used her knowledge of her kids past experiences to connect with new information she introduced in her lessons. Teacher 11 provides her high school students with rationales behind her lessons and makes authentic connections to their worlds, making her lessons more relevant to them.

There is a connection between what is considered pedagogically good practice and learner-centered practices (APA & McREL, 1993; Jones, et al., 1994; Lambert and McCombs, 1998; Means, 2003). There are considerable overlaps between the two frameworks (Means' Engaged Learning and Jones' Meaningful, Engaged Learning) and the Learner-Centered Principles indicating that there seems to be agreement on the connection between learner-centeredness and effective teaching practices.

In conclusion, teachers in this study valued instructional practices that wedded sound pedagogical instructional strategies with technology that resulted in an enhanced

learning experience. Their strategies are decidedly learner-centered. In the next section, I elaborate more on the connection between sound pedagogy and technology, and how both are valued tools for enhanced learning.

Sound Pedagogy Drives Technology Use. Teachers, without exception, agreed that technology is a powerful tool and resource to enhance teaching and learning. They felt that technology should be driven by curricular goals, that is, technology should not be used in the absence of a meaningful context. "Technology has to make sense, …should not be a force-fit" (Teacher 8). Also, a common statement expressed by many teachers summed up in Teacher 4's statement is that an important aspect of technology is it should be used in pedagogically sound ways: "pedagogy is first, technology works in partnership with students." Teacher 6 said that she only used technology to enhance teaching and that she did not believe in using technology just to show that she could use it. Technology, instead, is a tool to be used in conjunction with the curriculum. Overall, teachers felt technology provided multiple options to create activities and lessons that enhanced student learning. Some mentioned how motivating technology use is for students as well. All teachers expressed that technology was a necessity to use and have students use given its prevalence in our culture.

One value of technology consistently talked about was that diverse students could be accommodated. Many software programs allow students to work independently and at different levels of abilities. Many programs are highly interactive and can show concepts and processes in ways better than text-based materials (e.g. simulations, virtual tours). Student products also are more professional looking which is motivating to students who

can take great pride in their work. Another value many teachers mentioned was that communication is enhanced; students can connect with communities, other students from other school buildings and the world at large via the Internet. Students get first hand opportunities to develop more global perspectives.

The consensus seemed to be that technology used in pedagogically sound ways positively impacts student learning. Apparently, it is not about the technology itself, pedagogical expertise, instructional setting (e.g. the needs of diverse students), and curricular goals play a major role in determining how technology is used.

With or without technology, teachers agreed that interactivity was an important component in their teaching practices. For example, participant 6 and 7 had smart boards in their classrooms commented on their excitement about this technology because students could interact with it, get out of their seats, touch the board and see how it responded to their actions. These teachers felt this was motivating for students because students loved to move around and not be confined to their desks for long periods of time. Teacher 5 said that as a teacher, he uses a hands on approach, employs active learning strategies, so kids "do" physics and his choice of software are simulations, visually dynamic Internet sites that lend themselves well with the content being taught. According to him "there is a natural connection to content and technology." Very little is done without technology. In the lab, hands-on work is done with some discussion, but computers are at every lab station and used often for such activities as recording data or researching information to solve problems.

Repeated in many discussions with teachers about teaching lessons with or without technology, was the theme of active learning where students often work

collaboratively on problems or projects. Many of the problems or activities would be anchored in real-world situations. For example, Teachers 4, 5, 8, 10, and 11 talked about how they used the Internet extensively to help students develop research skills and reading/writing skills. In an informal conversation with Teacher 9, I noted that he said he based his instructional decisions on what he thought was important in the real-world context, then stressed that in the concepts and applications he introduced.

On one of my initial site visits to School District B, I talked briefly with a high school biology teacher. Although he did not participate as one of the teachers in the study, I was impressed by some of the projects his students created. This teacher involved students in collaborative projects about environmental issues. Students formed research teams that tested water samples of a particular pond over a period of time, keeping records and communicating with a New York museum biologist via the Internet to determine the age of the pond they were investigating. Students did not learn about science, they "did" science, playing the role of scientists. Students were expected to use scientific methods and report on their work using typical scientific formats of reporting.

Teacher 2 described how she would teach a geography lesson using the smart board. Students would click on countries projected on the board to find out climate information about a particular country. Probing questions would be asked requiring students to make inferences about climates near or far from the equator. The non-technology based lesson would be hands-on where students would create a map of a country using raw cookie dough, licorice to label regions, icing for rivers, toothpicks as flags, etc. Her lessons were interactive with or without technology.

Thus, beliefs about learning and how to design learning activities that promote learning could be seen in teachers' examples of how they taught with or without technology. Strategies did not change:

Table 4.22
Instructional Strategies With or Without Technology

Teacher 1	Technology is a tool, strategies and teaching methods are the same with or without technology. Art/drawing, building something, can use with or without technology, for example with technology…simulations, without technology….manipulatives…
Teacher 3	Strategies don't change, teaching is basically the same…Students do hands on work but may take pictures of their [art] work and load pictures on the H drive for their portfolio.
Teacher 7	Teaching strategies and methods haven't changed, still have the desire to help kids, my personality drives my teaching, it's who I am and technology only helps me do what I do better and that is to help students. Technology doesn't tell me what to do to meet needs of students, my observations from experience tell me what to do. I am improving and becoming aware and conscious of what I do in my practices and why I do them … helps me in evaluating software as well – if I think it meets student needs or is pedagogically sound…technology has enhanced teaching because I have more tools and resources on hand.
Teacher 10	My instructional beliefs and practices only change with regard to adding new tools, but not how to work with and alongside children.

Further indication of sound pedagogical technology use, in my estimation, was observed in Teacher 1's classroom lesson. The lesson introduced elementary students to spreadsheets. This teacher did not go immediately to the computer, but instead, gave a conceptual overview using diagrams and concepts maps drawn on a white board. Students were given an advance organizer relating the to-be-learned information with what was already a part of their experience. Students asked and answered questions about the components of a spreadsheet and their functions looking at a diagram of a grid. Some clever exchange went on about one of the components i.e. cell. The teacher wanted

students to understand the terminology used in conjunction with spreadsheets and guided them through the new concepts with familiar ideas connected to these new terms. This strategy exemplifies one of Vygotsky's principles about learning i.e. zone of proximal development (Vygotsky, 1978), that argues that students can, with help from adults or children who are more advanced, grasp concepts and ideas that they cannot understand on their own. For example, students were asked what they thought about when they heard the word "cell". This prompted many responses such as prison, brain, blood, skin, and cell phone. The teacher tried to get students to come to the idea of walls that "hold stuff in". I could see the connection between his strategy in this lesson and his definition of learning which states the importance of connecting new knowledge to existing knowledge. After the introduction, students worked in groups around the five classroom computers entering personal information about themselves. Some students in each group had some familiarity with spreadsheets and helped others in the group to enter information. Teacher 1 interacted with each group to help if needed. A connection with the strategy used by Teacher 1 and learner centered principle 1 (APA & McREL, 1993) and Jones et al. (1994) indicator 4 was clearly observed.

In summary, the emphasis on hands-on learning, discovery learning i.e. research, and learning a discipline by genuine engaging in the real work of that discipline (e.g. learning science by doing science) were exemplified in not only teachers' descriptions of their lessons and activities, but also evident in activities observed in class.

Summary of Pedagogical Expertise

It seemed to me that teachers in this study exemplified pedagogical expertise in their practices with little variability along the continuum of this variable. Although I did not observe all teachers, interview data primarily supported a connection between what these teachers said about their practices and effective teaching practices as outlined in appendices H-L. Teachers observed showed evidence of pedagogical expertise. However, the connection has been made between learner-centeredness and effective practices. One teacher in this study varied on the learner-centeredness continuum in that she exhibited more structure and teacher-directedness in the lesson she taught during our observation. I feel that this had more to do with the age of her students than her being more or less learner-centered. She felt her students needed more structure and provided that for them. In my estimation, this can also be interpreted as learner-centeredness because she is assessing the needs of her students and answering those needs. It would be interesting to see if she her instructional strategies would change if she taught older students. I think what might have been insightful if this study continued, would be to do another observation at the end of the school year to see if her strategies had changed to allow for increased small group work and/or independent self-directed learning.

Summary

Humane characteristics of the teachers in this study shine through in self-descriptions that shed light on their beliefs and attitudes about good qualities a teacher should possess to enhance the teaching and learning process. Although these teachers

have been identified as exemplary technology-using teachers, technology is placed secondary to the human aspects of teaching and the pedagogical expertise necessary to make learning happen. These teachers valued the human side of teaching, and did not see themselves as technicians. Human qualities such as caring, compassion, respect for students, a passion for teaching, and the genuine desire to help students develop life long skills (not only marketable skills for the workplace) needed for success as a citizen in a democratic rapidly changing society were evident. Teachers' flexibility and openness to change seemed to be more motivated by a genuine desire to do what is best for students rather than for their own self interest. A truly learner-centered approach seemed to be at the heart of their teaching, where student interests were considered a priority. These teachers realized that treating students as whole beings rather than just academic beings was an important part of their work. Technology could not take the place of the humanity of teaching. Thus, technology was viewed as a tool in the service of humans, and teachers did not allow technology to create an imbalance in their teaching roles. They felt comfortable in their own pedagogical expertise and collaborative support system available in their teaching contexts to embrace new technologies. For example, Teachers 3 and 7 expressed that knowing yourself was really important in feeling secure in your abilities to learn new things. You are more apt to take risks and risk failing, and that is what she wanted her students to learn as well. Teacher 3 wanted her students to take risks and not be afraid of failure because learning how to deal with failure is a life-skill worth developing. Many teachers shared this attitude. Fear of not always being in control of technology was not an obstacle that could have prevented teachers from showing students that at times teachers do not know it all.

As far as how these beliefs and attitudes were formed, no consistent pattern emerged, as teachers learned from good and bad experiences. Much of the valuable experiences came on the job, thus lending support to the value of apprenticeship learning and the efficacy of situated cognition (Brown et al., 1989). Teachers often expressed how they learned a great deal from their peers, especially those more experienced. They continued this collaborative peer exchange to help others whenever they could. Some of the components of apprenticeship learning include modeling, coaching and scaffolding (Collins et al., 1989). From teachers' descriptions of learning on the job, these components were evident in their training. One teacher remarked that he loves working with student teachers now because he had missed the mentoring he thought so valuable in learning how to teach.

Teachers' beliefs and attitudes were reflected in their instructional practices in ways that consistently showed that what teachers believed in, they put into practice. What they believed was part of who they were and what they did in the classroom. In general, they taught as they would have wanted to be taught, or in some fortunate cases, ways they were taught. The incorporation of technology into teaching did not change, for the most part, basic methods of teaching or instructional strategies. Technology provided more options and was considered a powerful tool, but served a master - pedagogical expertise.

CHAPTER 5

Discussion and Recommendations

Introduction

This chapter discusses the results of the study, and an emerging theory from the data presented in chapter 4. A discussion of the findings is presented first. Next, there is a discussion about the emerging theory and how the personal characteristics, contextual and pedagogical factors that emerged from the findings of this study interacted to produce and sustain exemplary technology-using teachers. Finally, I discuss implications for further research and practice.

Discussion of the Results

The purpose of this study was to describe exemplary technology-using teachers' beliefs and attitudes about teaching, learning, and technology use in education while uncovering the process of how these beliefs and attitudes are formed and are influenced by many contextual factors in the school culture. Finally, this study described how the exemplary technology-using teachers' beliefs and attitudes influenced their classroom practices with technology. Three research questions guided this research:

1. What are the beliefs and attitudes of exemplary technology-using teachers with respect to (a) the teaching and learning process and (b) the value of technology?

2. What has influenced the development of the beliefs and attitudes of exemplary technology-using teachers?

3. How have exemplary technology-using teachers' beliefs and attitudes affected their instructional practices?

The discussion of the findings of this study followed the main themes that emerged from the analysis of the data in the process of answering the research questions. Three main themes emerged:

1. The exemplary technology-using teachers were learner-centered in both their pedagogical beliefs and attitudes about teaching, learning, and technology use, and their personal beliefs and attitudes about learners (young people).

2. Past experiences as learners and present contextual factors shaped how these teachers became exemplary technology-using teachers.

3. The exemplary technology-using teachers possessed pedagogical expertise that influenced effective technology integration.

Theme 1: The Exemplary Technology-Using Teachers were Learner-Centered in Both their Pedagogical Beliefs and Attitudes about Teaching, Learning, and Technology Use, and their Personal Beliefs and Attitudes about Learners (Young People)

The findings of this study indicated that the exemplary technology-using teachers held learner-centered beliefs and attitudes about teaching and learning, and technology use that influenced how they integrated technology into their instructional practices.

The teachers shared the belief that students possess many different learning styles and it was their job to incorporate many teaching methods to accommodate diverse student needs. When teachers talked about how they taught, there were many references to how they used different methods of teaching involving multiple modalities (See Table

4.9). Findings from chapter 4 provided evidence that the teachers in this study believed in the importance of active learning and ensured that students had many opportunities to interact with material being taught. Evidence was provided from the teacher interviews (See Tables 4.11, 4.12). Closely connected to the belief of the importance of active learning was the belief that collaborative learning provided students with opportunities to actively engage in project work where peer learning could take place (See Tables 4.13, 4.14). The teachers talked about how they used collaborative learning in their classroom. It was apparent to me that the teachers saw themselves as facilitators in the teaching and learning process. They also saw the importance of taking students interests into account so that what students were learning was more relevant to them. APA & McREL (1993), Jones et al. (1994), and Means (2003) consider these factors as indicators of learner-centeredness. These learner-centered beliefs influenced how they used technology with students and how students used technology. The teachers talked about lessons they taught that involved students using technology without their being in complete control of the process. This was corroborated in the document analyses when I saw evidence in student products that they used a variety of software applications in creative ways.

With respect to the value that the teachers ascribed to technology in education, the teachers without exception agreed that technology is a powerful tool and resource to enhance teaching and learning. They felt that technology should be driven by curricular goals, that is, technology should not be used in the absence of a meaningful context. "Technology has to make sense, …should not be a force-fit" (Teacher 8). Also, a common statement expressed by many teachers summed up in Teacher 4's statement is that an important aspect of technology is it should be used in pedagogically sound ways:

"pedagogy is first, technology works in partnership with students." Teacher 6 said that she only used technology to enhance teaching and that she did not believe in using technology just to show that she could use it. Technology, instead, was a tool to be used in conjunction with the curriculum. Overall, teachers felt technology provided multiple options to create activities and lessons that enhanced student learning.

Moreover, during the discussions with the teachers they not only talked about their beliefs and attitudes about teaching and learning, and technology use, they also talked about themselves personally. Personal characteristics (self-beliefs) were factors in how these teachers taught with technology. Learner-centered personal beliefs and learner-centered beliefs about teaching and learning were intertwined, impacting on their teaching with technology. My belief is that the exemplary technology-using teachers were learner-centered personally, and this predisposed them to learner-centered beliefs and attitudes about how students learn. The teachers' self-beliefs put students' learning ahead of their own needs to control, manage, and dispense knowledge they may have deemed valuable in ways that suited their comfort level. Connected with this desire to put student needs ahead of their own were the teachers' personal characteristics of caring and compassion. During the teacher interviews, the teachers ascribed these characteristics to themselves (See Table 4.3).

Another personal characteristic that emerged consistently with all the teachers was their openness to change and their willingness to try new things (See Tables 4.7, 4.8). These teachers did not seem to fear taking risks in front of their students. Furthermore, the caring, respectful, and comfortable environments that these teachers attempted to create along with the willingness to try new things seemed to promote a

conducive learning environment for students and teachers to use technology in more confident and comfortable ways.

The teachers' pedagogical and personal beliefs and attitudes about teaching and learning, and technology use could not be separated. The teachers' personal learner-centered beliefs and attitudes were intermingled with their beliefs and attitudes about teaching and learning, and technology use, which indicated to me that who these teachers were as people affected how they approached their role in the teaching/learning process. The literature does not explore the personal characteristics of teachers and their pedagogical beliefs, attitudes, and practices adequately. This interaction is discussed further in the section on "Interaction of Personal, Contextual, and Pedagogical Factors."

Theme 2: Past Experiences as Learners and Present Contextual Factors Shaped How These Teachers Became Exemplary Technology-Using Teachers.

Past experiences as learners and present contextual factors shaped how these teachers became exemplary technology-using teachers. Two sub-themes emerged from this study. The first sub-theme was that these teachers had positive and negative experiences as learners that influenced their development into future (learner-centered) teachers. The second sub-theme was that a supportive and resource-rich learning environment positively influenced how these exemplary technology-using teachers effectively integrated technology.

When the teachers talked about past experiences that helped shape their beliefs and attitudes, they gave positive and negative examples. Teacher 10 talked about how comfortable his teachers made him feel in his early learning environment, and now he

wanted to make sure his own students felt comfortable because that seemed to promote a more conducive environment f or learning. Several teachers when talking about their early learning experiences talked about being sufficiently challenged, which made learning more motivating. When asked about memorable teachers, Teachers 1, 5 and 8 mentioned that their memorable teachers were those that made learning more relevant to them. They were also challenged to think and problem-solve. Teacher 4 talked about her home environment and how her father challenged her to answer her own questions. Teacher 2 and 7 talked about how interesting and enjoyable learning was made to be. Teacher 7 said she was inspired to teach by her grade 5 teacher (her most memorable teacher) because that teacher wanted her students to enjoy the learning process. Teacher 7 said she wanted to motivate her students in the same way so that her students wanted to be in her class to learn.

The negative experiences provided the teachers in this study with examples of what they did not want to do in their own teaching. For example, most negative examples focused on the lack of active learning opportunities. Teachers 1, 3, 8, 9, and 11 said they were bored in many of their classes because they had to sit and listen to the teacher and had few opportunities to be involved in hands-on learning (See Table 4.15). Teacher 1 said almost all his teachers except one throughout his grade school education did not vary their teaching methods. It was mostly lecture format. Teacher 7 had a teacher that taught through fear and intimidation. In many cases, students did not have a voice in their classrooms.

The teachers in this study, therefore, had early learning experiences that influenced their beliefs and attitudes about what they felt was important in the teaching

and learning process. It was apparent to me that these teachers remembered how they felt as students and, as a result, were concerned with how their own students felt in the learning environments they created.

To support sub-theme two, the data from interviews, field notes, and document analysis of this study indicated that the cultural/contextual environments of the teachers had strong influences on their beliefs and attitudes. Their cultural/contextual environment exhibited similar learner centered beliefs and attitudes with the exemplary technology-using teachers (See Tables 4.19, 4.21). The exemplary technology-using teachers' learning environments were supportive of their efforts to integrate technology effectively into their instructional practices (See Table 4.20). Furthermore, all districts provided resource-rich contexts that gave the teachers access to not only hardware and software, but also the professional training to use technology effectively. Professional development was on-going and focused on student learning (See Table 4.20). The importance of on-going professional development is supported by research conducted by Becker (1994) and Jones (1998), where they found that a lack of ample professional development opportunities created barriers to successful technology integration.

The teachers in this study were also encouraged to share their expertise (pedagogical and technical) with one another, and technical support was available to ensure that the teachers did not experience undue frustration with poorly functioning equipment. When the teachers talked about how they shared and supported one another in pedagogical and technology matters, I concluded that they exhibited "collegiality" (See Table 4.1). Collegiality was also found to be an important factor in effective technology integration in a study conducted by Becker (1994) on exemplary computer users, and

Hadley & Sheingold (1993) on teachers experienced at integrating computers into their teaching.

The research literature supports the assertion that a resource-rich learning environment with access to ample technology encourages greater technology use. The Apple Classrooms of Tomorrow (ACOT) studies are good examples of the importance of resource-rich (ample access to technology and professional development) learning environments in effective technology integration (Dwyer, et al., 1991; Dwyer, 1994; Sandholtz, Ringstaff, & Dwyer, 1997). Furthermore, recent research on effective technology integration practices supports professional development efforts that connect learner-centered pedagogical practices with effective technology integration, and recognize the need to train teachers in integrating effective pedagogical practices with technology use (Albion & Ertmer, 2002; Ertmer, 1999; Pederson & Liu, 2002; Pierson, 2001).

In conclusion, there seems to be ample agreement that a supportive learning environment is important in effective technology integration. This support takes various forms: technical and administrative support, access to technology, ample professional development opportunities, and a learning environment that encourages sharing (collegiality) of pedagogical and technology knowledge and expertise (See Table 4.1). My impression was that the teachers in this study had personal experiences as learners that helped shape their beliefs and attitudes about what they thought was good teaching (with or without technology), but I also had a sense that their present learning environments contributed more to how they *sustained* exemplary technology-using practices. The beliefs and attitudes of the school districts were very similar to those that

the exemplary technology-using teachers possessed (See Tables 4.4, 4.6, 4.10, 4.14), as evidenced by teacher interview data and my own field notes, therefore, this type of learning environment helped them to maintain effective technology integration practices. More research would have to be conducted to examine the personal process of acquiring beliefs and attitudes, and explore which factors or combination of factors carry more weight.

Theme 3: The Exemplary Technology-Using Teachers Possessed Pedagogical Expertise that Influenced Effective Technology Integration

Theme three explains how the exemplary technology-using teachers' beliefs and attitudes affected their instructional (pedagogical) practices. Based on the classroom observations merged with the conversations with the teachers, I concluded that the exemplary technology-using teachers' learner-centered beliefs and attitudes were consistent with their instructional practices (pedagogy). This conclusion was based on evidence from classroom observations. For example, I saw multiple instructional strategies being used in the same lesson, and student products that showed a variety of computer software applications, which coincided with the teachers' beliefs that using a variety of methods was necessary to accommodate diverse student needs. The teachers' practices were tested against their responses in the interviews describing the lessons they taught in the observations.

A consistent theme that emerged in the teacher interviews and observations was pedagogical expertise. When asked how these teachers thought that their beliefs about teaching and learning influenced their technology use, the main theme that surfaced was that effective technology use had a great deal to do with how they used technology

pedagogically (chapter 4, p. 129-130). These teachers believed that sound pedagogy was important when using technology as a tool. Curricular goals and sound pedagogical practices guided their technology use. Technology, they believed, helped them achieve curricular goals and enhanced their teaching practices, which positively influenced their students' learning. These teachers believed in the value of technology in education and how technology use could help them meet diverse student needs. The teachers understood that improving their craft meant using technology in effective ways because they all agreed that technology was a powerful tool to enhance teaching and learning.

In the observations of the teachers, I saw students doing group work and being given opportunities to use technology without the teachers' being in complete control of the process. Students worked independently and collaboratively on assignments or projects using computers or laptops. This provided me with evidence that the teachers' believed in the value of collaborative learning and the importance of peer learning, where their role as teachers was more of a facilitator than a dispenser of knowledge. The teachers also believed that taking student interests into account was important, and I saw in the observations that teachers used examples that were relevant to students. I also saw active participation on the students' part, especially when they worked in groups.

Moreover, not only the teachers' pedagogical skill was evident in the classroom observations, but also their technical skill as well. Support for my evaluation that these teachers possessed effective pedagogical practices came from Means' Engaged Learning Variables (Appendix H), Jones et al. Meaningful, Engaged Learning Framework (Appendix I), the National Educational Technology Standards for Teachers (Appendix J), and the APA & McREL Learner-Centered Principles (Appendix L).

The literature supports pedagogical expertise and effective technology integration (Pierson, 2001), and the connection between learner-centered beliefs, attitudes, and practices and effective technology integration (Jones, et al., 1995; ISTE, 2002; Sandholtz, Ringstaff, & Dwyer, 1997). The combined evidence from the literature and the findings of this study indicate a need for professional development that develops technology skills in conjunction with pedagogical skills. Again, the separation of the personal, contextual, and pedagogical does not make sense. Therefore, the exemplary technology-using teachers' pedagogical expertise influenced how they effectively integrated technology.

Towards an Emerging Theory of Exemplary Technology-Using Teachers

Theory is built on an intimate relationship with the data, with researchers very aware of themselves as instruments (Morse & Richards, 2002, p. 55). The theory that emerged from the data in this study fit the context for the period of time that constituted the duration of this study. For this reason, this theory is considered a substantive theory (Glaser & Strauss, 1967) not a formal one that can be generalized broadly across many contexts. It is an emerging theory that may be suitable for similar contexts to those of this study. Lincoln & Guba (1985) used the term *transferability* to convey the idea that concepts, ideas or "working hypotheses" (p. 123) may be used across similar contexts. The idea of working hypothesis helped me understand that my emerging theory was not a final conclusion but more like working hypotheses that take into account local conditions. There will always be factors that are unique to a certain context that make it useless to generalize broadly (Lincoln & Guba, 1985, p. 123).

Glaser & Strauss (1967) say that grounded theory may take different forms. Grounded theory "can be presented either as a well-codified set of propositions or in a running theoretical discussion, using conceptual categories and their properties." (p. 31). I have chosen the discussion form because the strategy of comparative analysis for generating theory puts a high emphasis on theory as process. The theory presented here is developing and not a perfected product. This perspective takes into account the reality of social interaction. The value of such kinds of theories is that researchers can use them in a sensitizing way when conducting further research, and the door is always open to modify and perhaps enhance the theories put forth based on differing contextual factors or local conditions. In this study, the emerging theory explains why the exemplary technology-using teachers used technology in exemplary ways in their instructional (pedagogical) practices.

Interaction of Personal, Contextual, and Pedagogical Factors

The findings of this study provided some support to hypothesize about why exemplary technology-using teachers use technology effectively in their instructional practices. The data suggest that: Teachers who are learner-centered are more likely to use technology in effective ways when (1) they are in supportive (learner-centered, resource-rich) contexts, and (2) they value technology as a means toward their own learner-centered teaching/learning goals. These teachers were exemplary technology-using teachers because their beliefs and attitudes about teaching and learning, and technology use successfully combined various personal, contextual, and pedagogical factors and

characteristics that enabled them to put into practice effective technology-based instruction.

The interaction of personal characteristics, contextual, and pedagogical factors had the effect of positively influencing how these teachers effectively used technology to achieve learning goals. The learning environment created by these teachers encouraged students to use technology in beneficial ways to enhance learning. In a caring, comfortable, and respectful environment students seemed to excel. The teachers also modeled comfort and confidence in teaching and using technology, which contributed to their technical skill and effective technology integration practices. The research literature supports the findings in this study that teachers who exhibited confidence in their ability to learn new technology skills and comfort with using technology tended to use technology more and implement technology at higher levels of integration (Honey & Moeller, 1990; Schechter, 2000). Ertmer, et al. (1998) also made the connection between teachers reported increased comfort with technology use and "technology as a curriculum support", and found that students, as a result, showed increased confidence, computer skills, and self-esteem. It has also been found that teachers' comfort and confidence with technology use and the resulting higher levels of technology integration are related to the amount computer training, on-going professional development of teachers, and increased information technology resources (Guha, 2000; McDermott & Murray, 2000; Ross et al., 1999). These factors had a positive impact on teachers' and students' technology use.

The teachers' openness to change and willingness to learn new things modeled excellent attitudes toward learning in general. In a context where trying new things was supported, the teachers showed a willingness to take more risks. Similar findings

occurred in a study done by Marcinkiewicz (1994) and reported in the review of literature on technology integration by Dupagne & Krendl (1992), where they found that not only self-competence of teachers predicted effective technology use, but also a willingness to change. Albion (1999) also stated that teachers' self-efficacy beliefs are "an important and measurable component of the beliefs that influence technology integration" as reported by Vannatta & Fordham (2004, p. 253). In the study conducted by Vannatta & Fordham (2004), they found the best combination of predictors of classroom technology use were technology training, time spent beyond contractual work week, and openness to change. These findings support the findings of this study in that the teachers had abundant technology training, spent time outside their working hours using a computer (See Table 3.6), and demonstrated an openness to change (See Table 4.7).

In this study, it was also very clear that the teachers held learner-centered beliefs about teaching and learning, which were closely connected to their effective technology use. The connection between learner-centered beliefs and effective technology integration was supported by other researchers as well (Dwyer, Ringstaff, & Sandholtz, 1991; Honey & Moeller, 1990; Pedersen & Liu, 2002; Sandholdz, Ringstaff, & Dwyer, 1997). This connection between beliefs about teaching and learning and effective technology integration was also documented in the literature, and was labeled not as learner-centered, but constructivist instead (Becker, 2001; Becker & Ravitz, 2001; Howard, et al., 2000; Ravitz, Becker, & Wong, 2000). I labeled the components in my study as learner-centered, but the same components found in the above referenced studies were labeled constructivist. Berg et al. (1998) also found that "exemplary technology-using teachers" held more constructivist beliefs about teaching and learning. Hadley and

Sheingold (1993) found that the more experienced teachers in their study who used technology well were more learner-centered in their practices.

The teachers in this study had support from administrators and technical support staff that created a learning environment that encouraged further learning and influenced the teachers' feelings of comfort and confidence with using technology. The school context also shared some of the personal characteristics of these teachers. It was evident that the districts in which these teachers taught cared about students and their learning and cared about the teachers' own professional development as well. The teachers' learner-centered personal characteristics (who they were as people) had a great deal to do with the learner-centered beliefs and attitudes they held with respect to teaching and learning. It was evident to me that their beliefs and attitudes about teaching and learning came from who they were as people, which means that they did not adopt these beliefs and attitudes in a disconnected way. They lived their beliefs through their practices, which I felt were consistent with who they were as people. However, their learning environments helped them express their personal beliefs.

Since I did not look at learning environments that were not supportive and resource-rich, I could not make claims about whether these exemplary technology-using teachers would have put into practice effective technology integration even in non-supportive and resource-poor learning environments. Some indication that teachers could integrate technology effectively in a less than resource-rich learning environment came from a study conducted by Ertmer et al. (1999). They found that teachers who were using computers effectively in their classrooms perceived the barriers of lack of equipment, time, and classroom help not as insurmountable as other teachers. Their

beliefs that students benefited, and the belief that technology helped enhance teaching and learning won out over such barriers.

Nevertheless, the research literature has supported the fact that certain factors in the learning environment of teachers were important in creating and sustaining teachers who integrated technology well. In studies conducted by Jones (1998), Becker (1994) and Hadley & Sheingold (1993), similar findings concerning the importance of the learning environment supported my study. Becker (1994) found that in the teaching environment of exemplary computer users there was more likely to be collegiality among users, school support for using computers for consequential activities, and ample resources for professional development. Jones (1998) found that a major obstacle to technology integration was a lack of professional development to help teachers develop effective, technology-supported instructional activities. In Jones' study effective technology-supported instructional activities placed an emphasis on technical skills in a meaningful context, not on technical skills in isolation. Hadley & Sheingold (1993) also found that those teachers who integrated technology well had support (e.g., local training opportunities, on-site help available, access to more technology). Hadley & Sheingold (1993) found that the teachers in their study shared their expertise with one another (collegiality). They found that on-site support and "colleagueship" were critical ingredients to successful technology use. The Apple Classroom of Tomorrow (ACOT) studies (Dwyer, 1994; Sandholtz, Ringstaff, & Dwyer, 1997) also attested to the profound changes in teachers' effective technology use given a resource-rich learning environment. Such an environment facilitated a transformation of their teachers' learning cultures to more learner-centered beliefs and practices as well.

On the other hand, Cuban (1993; 1999; 2001) has maintained that access to technology and resource-rich learning environments have not transformed many teachers' instructional practices from traditional methods of teaching to more progressive teaching methods that include more effective technology use. Becker & Ravitz (2001) agreed with Cuban's findings of low levels of computer integration, however, they disagreed with Cuban's prediction that computers are incompatible with the requirements of teaching. For example, Cuban cited classroom size, not enough time for teaching training, or time in the schedule to use technology (given its unreliability), as deterrents to using accessible technology (Cuban, 1999). Becker & Ravitz (2001) found in the data from a national survey of 4,100 teachers' pedagogy, computer use, and teaching environment, that where teachers had reasonable expertise in using computers themselves, 5 to 8 computers in their own classroom, and believed more strongly in a constructivist pedagogy that made learning activities meaningful to students, a clear majority of teachers had students use computers regularly in their academic classes. Moreover, teachers who were more broadly engaged with their teacher peers in collaborative roles were much more likely than the average teacher to have their students use computer resources during class. These findings point to a need for not only access to technology, training, and support of technology integration practices, but also the need to change beliefs (teaching philosophies) that are positively linked to effective technology integration (i.e. constructivist and learner-centered beliefs). Thus, context factors and beliefs interact in certain ways to produce more effective technology integrators.

Furthermore, the interaction of context and certain beliefs about teaching influenced how the teachers of this study put into practice their beliefs about teaching and

learning. In a learning context that shared similar beliefs and attitudes about teaching and learning, these teachers expressed those supported beliefs and attitudes in their learning environments consistently. The teachers and their districts, for example, shared beliefs that students learned in diverse ways. Collaborative learning was valued by the teachers and their respective districts as evidenced by the types of activities and assignments that students were involved with. There also seemed to be an agreement that pedagogical expertise was necessary in order to effectively integrate technology. Although, accesses to technology and support for technology integration were important factors in the teachers' effective technology integration instructional practices, what they considered more important were pedagogical strategies that helped them to use the technology effectively. The teachers in this study felt it was important to tailor their technology integration instructional practices to suit diverse student learning styles. They also took into consideration matching technology with learning goals and the ability level of their students. In the research literature, it has been shown that pedagogical expertise involves planning about how to use instructional strategies based on knowledge about students (e.g., prior knowledge, learning styles, etc.) (Pierson, 2000), which is consistent with the findings of this study. Pierson (2000) also found differences in her investigation of teachers at various levels of technology integration and teaching ability. She found that exemplary technology integrators' effective use of technology was closely linked to their higher levels of general teaching expertise. The findings of her study support the emergent theory set forth in this study of exemplary technology-using teachers.

Implications for Further Research

One of the important implications of this study is that educational research requires a contextual approach that takes into consideration a complex mix of variables that interact in the production of outcomes. One needs to take a systemic view of factors that impact teachers, whose instructional practices show integration of technology in exemplary ways. The reasons why certain teachers are exemplary technology-using teachers are intertwined among many factors each exerting varying degrees of importance.

In this study I found similar personal characteristics shared among the teachers, similar beliefs about how learners learn, and some similar characteristics of their school culture/context. There was also a consistency between beliefs and attitudes and instructional practices. I was left with some unanswered questions, however. For example, what if exemplary technology-using teachers found themselves in a less supportive school district? How much of a negative impact would there be on their instructional practices? Research exploring teachers who share the beliefs and attitudes of exemplary technology-using teachers in this study but who do not express those beliefs and attitudes in their practices might help in answering these questions. As Jerome Bruner's cognitive-interactionist theory states: one acts on the basis of one's beliefs, expectations, needs and motives, which have been influenced by one's interactions with the social environment (Bigge & Shermis, 1992). In this study, the cultural environment facilitated the expression of learner-centered beliefs and attitudes into learner-centered

instructional practices. In a cultural environment that does not share one's beliefs and attitudes, what other factors might exert more influence on behavior?

I would also like to test my hypothesis in a larger study to see if similar findings occur regarding what degree of resource-rich and supportive learning environments positively influences effective technology integration.

Another question worthy of further research asks if and why teachers in technology-rich districts that encourage and support learner-centered instruction still teach in traditional ways. Further research might explore a comparison between exemplary technology-using teachers vs. non-exemplary technology-using teachers' beliefs and attitudes in the same districts. Furthermore, conducting a similar study using a larger sample of school districts that could be randomly selected, would make for a more powerful and more broadly based study useful for more contexts.

An interesting phenomenon occurred in this study that I thought warranted some further research. I found it interesting that the teachers did not feel comfortable with being called "exemplary technology-using". Many of these teachers mentioned that they did not consider themselves exemplary when asked why they thought they were identified by technical coordinators or principals as such (Research Question 3.4: *Why do you think someone might identify you as an exemplary technology-using teacher?)*. In conversations with these teachers, they felt much more comfortable when different wording was used i.e., teachers who integrate technology well into their teaching practices. There might be a connection between these teachers' self-effacing attitudes and learner-centered personal beliefs. Further research might provide some insight into this issue.

An argument could also be made that these teachers were making an effort to create a good impression knowing they had the reputation of being exemplary by their superiors. The lessons observed may not have been their norm. Technical coordinators and principals were not interviewed so this issue was not addressed. Interviewing technical coordinators and principals could provide more insight about what criteria they used in identifying exemplary technology-using teachers, and would be a worthwhile avenue to pursue in a larger research study.

While the data provided some insight into why teachers felt some discomfort with the term exemplary, these assumptions need to be investigated more directly. When teachers were describing themselves as teachers, their responses were characterized as being learner-centered. They talked mostly about the needs of their students and meeting the needs of their students. My impression was that these teachers were not driven by ego. Further evidence for this was the value the teachers placed on sharing and supporting one another. Collegiality was highly prized. The teachers in this study recognized that in their changing learning environment (especially with technology changes and upgrades), focusing on developing and maintaining supportive learning relationships was an important factor in enhancing student learning. Therefore, I concluded that ego was not a strong personal characteristic and I think this may be underlying their spirit of collegiality and willingness to support one another. Given this perspective, I can understand why these teachers would have a problem with "exemplary" perhaps because it has connotations of stratification and carries with it the notion that one is better than another. I did not see these teachers as competitive with one another. Further research might shed light on these teachers' egocentricity.

Further study on learner-centered beliefs with non-exemplary technology-using teachers could reveal some personal characteristics that are not consistent with learner-centeredness and shed more light, from another perspective, on the connection between learner centeredness and exemplary technology use. This may have implications for thinking about what an effective teacher is, both personally and professionally.

Other personal characteristics such as ego-centrism may be explored more closely as it connects to learner-centered beliefs. In this study, my impression was that these teachers were not very ego driven. Their students definitely came first. This may also be the underlying characteristic of an openness to change. New research in this area may provide useful answers.

Exploring the personal domain may be another fruitful avenue of research. For example, one question that might be worthy of further exploration is how resistant to change are beliefs and attitudes. The literature supports the idea that beliefs are deeply ingrained and highly resistant to change (Dwyer, et al., 1991; Kagan, 1992; Pajares, 1992) and teachers in this study tended to agree (Table 4.1). However, teachers in this study also believed in the value of being open to change and willing to change. These findings indicate to me that openness and willingness to change is not a one-dimensional personal characteristic. Teachers recognized that their openness and willingness to change and try new things was an important factor in improving teaching and student learning. So, presumably they would change because the motivation to change is rooted in teachers' beliefs that benefits might accrue to students (learner-centered motivation). I don't think that the teachers in this study would be open to changing their learner-centered beliefs unless other values superceded those values.

In summary, such lines of research may contribute to a new framework for professional development that includes a more personal aspect to teaching that incorporates technology in humanistic ways.

Implications for Practice

Using the perspective of transferability (Lincoln & Guba, 1985), I believe the results of this study may have some implications for creating a new framework for professional development for enhanced technology integration in contexts similar to that of this study. From the lessons learned about the teachers' self-beliefs and personal characteristics, their supportive, resource-rich learning environments, and their effective instructional practices, several ideas may be valuable to incorporate into a professional development framework.

First, professional development is about people and their humanity. While technical, cultural, and pedagogical elements in a professional development program are very important, the formation of an educator's self-identity and personal role are also essential in relationship building with teachers, peers, learners, and administrators. As the results of this study indicated, a caring and respectful relationship in a comfortable learning environment influenced more effective technology use on the part of the teachers and students. This relationship building with students also engaged them more actively in the learning process, which positively influenced their technology use. Teachers also established a sharing peer relationship, which helped them learn from each other and

support each other in technology use. Heretofore, the personal domain has been virtually absent in many professional development programs.

Second, professional development should not be disconnected from the learning environment. In a culture of learning, knowledge and skills should be constantly shared and expanded. Embedded in the daily life of teaching and learning, professional development should find a place woven into the landscape of the learning environment that stretches even beyond classrooms and schools. This study indicated that a supportive and resource-rich learning environment helped teachers translate their learner-centered beliefs and attitudes into learner-centered practices. These learner-centered practices were connected to effective technology integration. In an atmosphere of collegiality, teachers learned from each other on a continual basis sharing a wealth of pedagogical and technology knowledge which contributed to their comfort and confidence with using technology. Students also benefited by the teachers' growing expertise. Developing expertise, whether pedagogical or technological should be an on-going process that is a journey, not an end result.

Third, professional development and district goals should share a common value of improving student learning. As evidenced in this study, a common sharing of beliefs and attitudes about learning and a focus on student learning helped create a conducive, supportive environment that resulted in effective teaching practices. Professional development that incorporates shared beliefs and visions for learning leads to a more integrated approach to teaching and learning. Such an approach also recognizes the systemic nature of a learning community that extends beyond classrooms and schools. For example, a community should be supportive to the vision of learning embraced by a

school district. Without community support school administrators and teachers could face objection to decisions concerning instructional practices. Synergy can be a powerful force for reform efforts that include the effective integration of technology in teaching. It was evident in this study that the district made an effort to connect with their communities and be responsive to them.

Fourth, professional development should primarily focus on learners and learning. Too often, the focus of professional development is on developing knowledge and skills disconnected from the learners' needs. Focus may be on activities or speakers in workshops but not on teachers' contexts that bring them back to their learners' diversified needs. Professional development efforts should always be connected to instructional practice that incorporates what is known about learning from cognitive science. The teachers in this study talked about some of these principles such as the influence of prior knowledge on learning, the importance of connecting new material to prior knowledge, the need to actively interact with new material. Furthermore, training focused on not only the development of technical skills, but pedagogical skills that helped the teachers develop skills in effective technology integration. Pedagogical expertise was also highly valued by them. This expertise in pedagogy, technology, and knowledge about how learners learn interacted to help the teachers more effectively integrate technology.

Finally, administrators should be leading the way in the establishment of a community of learning that includes not just teachers, but also administrators, parents, and community members. A systemic approach can encourage a shared vision, which should positively contribute to a supportive learning community that supports effective technology integration. Administrators should assume the leadership role in keeping the

learning community connected. They should also be modeling for teachers effective technology use as a show of leadership and support. In this study, administrators provided good role models of support for technology integration and recognized the importance of creating a learning community that reinforced shared beliefs and attitudes about teaching and learning.

Conclusion

The purpose of this study was to describe exemplary technology-using teachers' beliefs and attitudes about teaching, learning, and technology use in education while uncovering the process of how these beliefs and attitudes are formed and are influenced by many contextual factors in the school culture. Furthermore, this study sought to explain how these exemplary technology-using teachers developed their beliefs and attitudes about teaching and learning, and technology use. The findings of this study contribute to a knowledge base of effective technology integration at the K-12 level of education. This study found that the exemplary technology-using teachers held learner-centered personal beliefs, and learner-centered beliefs and attitudes about teaching and learning that influenced how they effectively integrated technology into their instructional practices. This study pointed to reasons why these exemplary technology-using teachers effectively integrated technology, suggesting that their supportive (learner-centered, resource-rich) contexts positively influenced how they translated their learner-centered beliefs and attitudes into learner-centered, technology-based instructional practices. These outcomes may help in identifying characteristics of professional

development efforts that can result in enhanced learning for students. As Collis (1996) has said, the teacher is the key in the eventual success or lack of success of any computer-in education initiative. Implications from this study also suggest that learner-centered personal characteristics such as caring and compassion, interest and respect for students, and willingness to change are related to learner-centered instructional practices and exemplary technology use, which may imply a need for professional development efforts to focus on personal characteristics, as well as cultural/contextual and pedagogical issues in a systemic way. In addition, to date very little research has focused on the personal domain in teaching as revealed in a review of the literature. I believe that teachers' personal characteristics contribute a great deal to the technology integration equation.

The implications for practice may be that teachers learn more effective ways of building relationships with students that treat students more holistically, not just academically. Furthermore, schools might move more in the direction of becoming professional learning communities that promote teacher collegiality along with continuous professional development so that training is not fragmented and isolated. Instead, professional development opportunities should be on-going with mentoring as an established part of the school culture.

This study points to new directions for further research and renewed consideration of existing professional development efforts that can help teachers build humanistic learning relationships with students and each other supported by a positive school culture where vision and values are shared. The need for contextualized research that takes into consideration the interaction of many variables in any educational context seems quite clear.

REFERENCES

Albion, P. R., & Ertmer, P.A. (2002). Beyond the foundations: The role of vision and belief in teachers' preparation for integration of technology. *TechTrends*, *46*(5), 34-38.

Albion, P.R. (1999). Self-efficacy as an indicator of teachers' preparedness for teaching with technology. *Technology and Teacher Education Annual,1999, (Society for Information Technology & Teacher Education*, Charlottesville, VA: Association for the advancement of Computing in Education.

Allport, G. (1967). Attitudes. In M. Fishbein (Ed.), *Readings in attitude theory and measurement*. New York: John Wiley.

American Psychological Association and Mid-Continent Regional Educational Lab (McREL). (1993). *Learner-centered psychological principles: Guidelines for school redesign and reform.* Presidential Task Force on Psychology in Education. Office of Educational Research and Improvement.

Babbie. E. (2002). Excerpts on measurement, unit of analysis and conceptualization. *The practice of social research*. Stamford, CT: Wadsworth.

Baker, E., Gearhart, M., & Herman, J**.** (1994). Evaluating the Apple classroom of tomorrow. In E. Baker and J. O'Neill, Jr. (Eds.), *Technology assessment in education and training* (pp.) Hillsdale, NJ: Lawrence Erlbaum.

Bandura, A. (1971). *Psychological modeling*. Chicago: Atherton.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*(2), 117-148.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.

Beaudin, L. C. (1999). *Computer self-efficacy and classroom practice: What is the correlation?* Unpublished master's thesis, University of Lethbridge (Canada), Lethbridge, Alberta, Canada.

Becker, H. J. (1994). How exemplary computing-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. *Journal of Research on Computing in Education, 26*(3), 291-321.

Becker, H. J. (1999). Internet use by teachers: Conditions of professional use and teacher-directed student use. *Teaching, learning, and computing: 1998 National Survey. Report #1*. Irvine, CA: Center for Research on Information Technology and Organizations, University of California, Irvine. Available online: http://www.crito.uci.edu/TLC/FINDINGS/internet-use/.

Becker, H. J. (2001). *How are teachers using computers in instruction*? Paper presented at the American Educational Research Association, Irvine, CA.

Becker, H. J., & Ravitz, J. (1999). The influence of computer and Internet use on teachers' pedagogical practices and perceptions. *Journal of Research on Computing in Education, 31*(4), 356-384.

Berg, S., Benz, C., Lasley, T., & Raisch, C. D. (1998). Exemplary technology use in elementary classrooms. *Journal of Research on Computing in Education, 31*(2), 111-122.

Bigge, M., & Shermis, S. (1992). *Learning theories for teachers*. New York: Addison Wesley Longman.

Bogdan, R. C., & Biklen, S. K. (1992). *Qualitative research for education: An introduction to theory and methods*. Boston: Allyn & Bacon.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of teaching. *Educational Researcher, 18*, 32-42.

Brush, T., Armstrong, J., Barbrow, D., & Ulintz, L. (1999). Design and delivery of integrated learning systems: Their impact on student achievement and attitudes. *Journal of Educational Computing Research, 21*(4), 475-486.

Charmaz, K. (2000). Grounded theory: Objectivist and constructivist methods. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp. 509-535). Thousand Oaks, CA: Sage.

Cognition and Technology Group at Vanderbilt (CTGV). (1990). Anchored instruction and its relationship to situated cognition. *Educational Researcher, 19*(6), 2-10.

Cognition and Technology Group at Vanderbilt (CTGV). (1994). Multimedia environments for enhancing student learning in mathematics. In S. Vosniadou, E. De Corte, & H. Mandl, *Technology-based learning environments: Psychological and educational foundations* (pp. 167-173). Berlin: Springer-Verlag.

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L.B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 453-494). Hillsdale, NJ: Erlbaum.

Collis, B. (1996). The Internet as an educational innovation: Lessons from experience with computer implementation. *Educational Technology, 36*(6), 21-30.

Cradler, J. (1994). Summary of current research and evaluation findings on technology in education [Online]. Available online: http://www.wested.org/techpolicy/refind.html

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions.* Thousand Oaks, CA: Sage.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Cuban, L. (1993). How teachers taught: *Constancy and change in American classrooms 1890-1990* (2nd ed.). New York: Teachers College.

Cuban, L. (1999). The technology puzzle. Education Week. Available online: http:// www.edweek.org/ew/ews/TheTechnologyPuzzle.

Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University.

David, J. L. (1994). *Realizing the promise of technology: The need for systemic education reform.* Available online: http://inet.ed.gov/pubs/EdReformStudies/SysReforms/david7.html.

Dirksen, D. J., & Tharp, D. (2000, June). *Moving beyond the crossroads: Teachers as agents for change.* Paper presented at the meeting of the National Educational Computing Conference, Atlanta, GA.

Dupagne, M., & Krendl, K.A. (1992). Teachers' attitudes toward computers: A review of the literature. *Journal of Research on Computing in Education*, 24(3), 420-429.

Dwyer, D. C. (1994). Apple classrooms of tomorrow: What we've learned. *Educational Leadership, 52*, 4-10.

Dwyer, D. C., Ringstaff, C., & Sandholtz, J. H. (1991). Changes in teachers' beliefs and practices in technology-rich classrooms**.** ***Educational Leadership, 48*****,** 45-52.

Education Week. (2001, May 10). *Technology counts 2001*. Retrieved October27, 2002, from http://www.edweek.org/sreports/tc01.

Ertmer, P. **A.** (2001). VisionQuest: Journeys in technology integration. Available online: http://www.edci.purdue.edu/ertmer/projects.htm.

Ertmer, P.A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development, 47*(4), 47-61.

Ertmer, P. A., Addison, P., Lane, M., Ross, E., & Woods, D. (1999). Examining teachers' beliefs about the role of technology in the elementary classroom. *Journal of Research on Computing in Education, 32*(1), 54-69.

Fang, Z. (1996). A review of research on teacher beliefs and practices. *Educational Research, 38*(1), 47-65.

Fletcher-Flinn, C., & Gravatt, B. (1995). The efficacy of computer assisted instruction (CAI): A meta-analysis. *Journal of Educational Computing Research, 12*(3), 219-242.

Fullan, M. (2001). *The new meaning of educational change*. New York: Teachers College.

Garbosky, J. (1994). Revisiting the experiences of educational technologists in public education. *Educational Technology, 34*(3), 43-49.

Gearhart, M., Herman, J., Baker, E., Novak, J., & Whittaker, A. (1994). A new mirror for the classroom: A technology-based tool for documenting the impact of technology on instruction. In E. Baker & J. O'Neill, Jr. (Eds.), *Technology assessment in education and training* (pp. 153-172). Hillsdale, NJ: Lawrence Erlbaum.

Glaser B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for* qualitative research. New York: Aldine de Gruyter.

Goldman, S., Petrosino, A., Sherwood, R., Garrison, S., Hickey, D., Bransford, J., & Pellegrino, J. (1994). Multimedia environments for enhancing science instruction. In S.Vosniadou, E. De Corte, & H. Mandl, *Technology-based learning environments: Psychological and educational foundations* (pp. 89- 96). Berlin, Germany: Springer-Verlag.

Guha, S. (2000). *A comparative analysis of present and preferred situations of elementary grade teachers in using computers for classroom instruction.* (Reports-Research 143). Temple University, Pennsylvania.

Guskey, T. (1986). Staff development and the process of teacher change. *Educational Researcher, 15*(5), 5-12.

Hadley, M., & Sheingold, K. (1993). Commonalities and distinctive patterns in teachers' integration of computers. *American Journal of Education, 101*, 261-315.

Hannafin, R. D., & Savenye, W. C. (1993). Technology in the classroom: The teachers' new role and resistance to it. *Educational Technology, 33*(6), 26-31.

Hashweh, M. (1996). Effects of science teachers' epistemological beliefs in teaching. *Journal of Research in Science Teaching, 33*(1), 47-63.

Heinecke, W., Blasi, L., Milman, N., & Washington, L. (1999). New directions in the evaluation of the effectiveness of educational technology. Available online: http://www.ed.gov/print/rschstat/eval/tech/techconf99/whitepapers/paper8.html.

Herman, J. L**.** (1994). Evaluating the effects of technology in school reform. In B. Means (Ed.), *Technology and education reform: The reality behind the promise* (pp. 133-167). San Francisco: Jossey-Bass.

Honey, M., Carrigg, F., & Hawkins, J. (1998). Union city online: An architecture for networking and reform. In C. Dede (Ed.), *Learning with technology* (1998 ASCD Yearbook) (pp. 121-139). Alexandria, VA: Association for Supervision and Curriculum Development.

Honey, M., McMillan-Culp, K., & Carrigg, R. (2000). Perspectives on technology and education research: Lessons learned from the past and present. *Journal of Educational Computing Research, 23*(1), 5-14.

Honey, M., & Moeller, B. (1990). *Technology beliefs and technology integration: Different values, different understandings* (Technical Report No. 6). New York: Center for Technology in Education.

Howard, B.C., McGee, S., Schwartz, N., & Purcell, S. (2000). The experience of constructivism: Transforming teacher epistemology. *Journal of Research on Computing in Education, 32*(4), 455-465.

International Society for Technology in Education (ISTE). (2002). *National Educational Technology Standards for Teachers: Preparing teachers to use technology*. Eugene, OR: ISTE.

Jacobson, M. J., & Spiro, R. J. (1994). A framework for the contextual analysis of technology-based learning environments. *Journal of Computing in Higher Education, 5*(2), 3-32.

Johnson. D. L. (1997). Integrating technology in the classroom: The time has come. *Computers in the Schools, 13*(1/2), 1-5.

Jones, B., Valdez, G., Nowakowski, J., & Rasmussen, C. (1994). *Designing learning and technology for educational reform.* Oak Brook, IL: North Central Regional Educational Laboratory.

Jones, B., Valdez, G., Nowakowski, J., & Rasmussen, C. (1995). *Plugging in: Choosing and using educational technology.* Washington, DC: Council for Educational Development and Research. Available online: http://www.ncrel.org/sdrs/edtalk/toc.htm.

Jones, C. A. (2001). Tech support: Preparing teachers to use technology. *Principal Leadership, 1*(9), 35-39.

Kagan, D. M. (1992). Implications of research on teacher belief. *Educational Psychologist, 27*(1), 65-90.

Krajcik, J., Soloway, E., Blumenfeld, P., & Marx, R. (1998). Scaffolding technology tools to promote teaching and learning in science. In C. Dede (Ed.), *Learning with technology* (1998 ASCD Yearbook) (pp. 31-45). Alexandria, VA: Association for Supervision and Curriculum Development.

Krendl, K. A., & Clark, G. (1994). The impact of computers on learning: Research on in-school and out-of-school settings. *Journal of Computing in Higher Education, 5*(2), 85-112.

Kulik, C. C., & Kulik, J. A. (1991). Effectiveness of computer-based instruction: An updated analysis. *Computer in Human Behavior, 7*, 95-94.

Kulik, C. C., Kulik, J. A., & Bangert-Drowns, R. L. (1985). Effectiveness of computer-based education in elementary schools. *Computers in Human Behavior, 1*, 59-74.

Kulik, J. A. (1994). Meta-analytic studies of findings on computer-based instruction. In E. Baker & J. O'Neill, Jr. (Eds.), *Technology assessment in education and training* (pp. 9-33). Hillsdale, NJ: Lawrence Erlbaum.

Lambert, N. M., & McCombs, B. L. (1998). Introduction: Learner–centered schools and classrooms as a direction for school reform. In N. M. & B. L. McCombs (Eds.), *How students learn: Reforming schools through learner-centered education* (pp. 1-22). Washington, DC: American Psychological Association.

Lebruto, D. J. (2001). *A study of intermediate elementary teachers' educational beliefs and teaching practices and the use of technology.* Doctoral dissertation, University of Central Florida, 2001. *Dissertation Abstracts International*, 62/01.

Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage.

Lincoln, Y., & Guba, E. (2000). Paradigmatic controversies, contradictions, and emerging confluences. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research.* (pp. 163-188). Thousand Oaks, CA: Sage.

Lumpe, A. T., & Chambers, E. (2001). Assessing teachers' context beliefs about technology use. *Journal of Research on Technology in Education, 34*(1), 93-107.

McCombs, B. L., & Whisler, J. S. (1997). *The learner-centered classroom and school: Strategies for increasing student motivation and achievement.* San Francisco: Jossey-Bass.

McDermott, L., & Murray, J. (2000*). A study on the effective use and integration of technology into the primary curriculum*. Unpublished master's thesis, Saint Xavier University, Chicago, Illinois.

McKinney, M., Sexton, T., & Meyerson, M. (1999). Validating the efficacy-based change model. *Teaching and Teacher Education, 15*, 471-485.

Marcinkiewicz, H. R. (1994). Computers and teachers: Factors influencing computer use in the classroom. *Journal of Research on Computing in Education, 26*(2), 220-237.

Means, B. (1994). Using technology to advance educational goals. In B. Means (Ed.), *Technology and education reform: The reality behind the promise* (pp. 1-21). San Francisco: Jossey-Bass.

Means, B. (n.d.). *Classroom variables indicating effective teaching and learning*. Retrieved December 12, 2003 from http://archive.ncsa.uiuc.edu/Edu/icm/html/engaged.html.

Milken Exchange Foundation. (1999). *The impact of education technology on student achievement.* Available online: http://www.milkenexchange.org.

Mills, S. C. (1999). *Integrating computer technology in classrooms: Teachers' concerns when implementing an integrated learning system*. Paper presented at the meeting of the Society for Information Technology and Teacher Education International Conference, San Antonio, TX.

Moersch, C. (2001). Next steps: Using LoTi as a research tool. *Learning and Leading with Technology, 29*(3), 22-27.

Morse, J., & Richards, L. (2002). *Readme first for a user's guide to qualitative methods.* Thousand Oaks, CA: Sage.

Nespor, J. (1987). The role of beliefs in the practice of teaching. *Journal of Curriculum Studies, 19*(4), 317-328.

Niederhauser, D. S., & Stoddart, T. (2001). Teachers' instructional perspectives and use of educational software. *Teaching and Teacher Education, 17*, 15-31.

North Central Regional Educational Laboratory. (1999). *Critical issues: Using technology to improve student achievement* [Online]. Available online: http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te800.htm.

Norton, S., McRobbie, C., & Cooper T. (2000). Exploring secondary mathematics teachers' reasons for not using computers in their teaching: Five case studies. *Journal of Research on Computing in Education*, 33(1), 87-108.

Norum, K. E., Grabinger, R. S., & Duffield, J. A. (1999). Healing the universe is an inside job: Teachers' views on integrating technology. *Journal of Technology and Teacher Education, 7*(3), 187-203.

Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*(3), 307-332.

Pandit, N. R. (1996). The creation of theory: A recent application of the grounded theory method. *The qualitative report*, *Vol. 2(4)*. Retrieved November 19,2001 from http://www.nova.edu/ssss/QR/QR2-4/pandit.html.

Pedersen, S., & Liu, M. (2002). *Teachers' beliefs about student-centered learning: A case study.* Paper presented at the meeting of the Association of Educational Communications and Technology, Dallas, TX.

Piantanida, M., & Garman, N. (1999). *The qualitative dissertation: A guide for students and faculty*. Thousand Oaks, CA: Sage.

Pierson, M. E. (2001). Technology integration practice as a function of pedagogical expertise. *Journal of Research on Computing in Educatio*n*, 33*(4), 414-430.

Powell, R. (1996). Epistemological antecedents to culturally relevant and constructivist classroom curricula: A longitudinal study of teachers' contrasting world views. *Teacher and Teacher Education, 12*(4), 365-384.

Prawat, R. S. (1992). Teachers' beliefs about teaching and learning: A constructivist perspective. *American Journal of Education, 100*, 354-395.

Ravitz, J. L., Becker, H. J., & Wong, Y. T. (2000). *Constructivist-compatible beliefs and practices among U.S. teachers* (Teaching, Learning, and Computing: 1998 National Survey, Report #4). Centre for Research on Information Technology and Organizations, University of California, Irvine.

Ravitz, J. L., & Snow, J. H. (1998). *Constructivist-compatible teacher beliefs and practices in American school: Prevalence and correlates*. (Teaching, Learning, and Computing: 1998 National Survey, Special Report). Centre for Research on Information Technology and Organizations, University of California, Irvine.

Reigeluth, C. M. (1999). What is instructional-design theory and how is it changing? In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory, Vol. II* (pp. 5-29). Mahwah, NJ: Lawrence Erlbaum.

Reil, M., & Becker, J. H. (2000). *The beliefs, practices and computer use of teacher leaders* (Teaching, Learning, and Computing: 1998 National Survey, Special Report). Center for Research on Information Technology and Organizations, University of California, Irvine.

Renzagilia, A., Hutchins, M., & Lee, S. (1997). The impact of teacher education on the beliefs, attitudes, and dispositions of preservice special educators. *Teacher Education and Special Education, 4*, 360-377.

Richardson, V. (1996). The role of attitudes and beliefs in learning to teach. In J. Sikula (Ed.), *Handbook of research on teacher education* (pp. 102-119). New York: Macmillan.

Rosen, L., & Weil, M. (1995). Computer availability, computer experience and technophobia among public school teachers. *Computers in Human Behavior, 11*(1), 9-11.

Ross, J. A., Hogaboam-Gray, A., & Hannay, L. (1999). Predictors of teachers' confidence in their ability to implement computer-based instruction. *Journal of Educational Computing Research, 21*(1), 75-97.

Sandholtz, J. H., Ringstaff, C., & Dwyer, D.C. (1997). *Teaching with technology: Creating student-centered classrooms.* New York: Teachers College.

Scarmadalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. *The Journal of the Learning Sciences, 3*(3), 265-283.

Schechter, E. L. (2000). *Factors relating to classroom inplementationof computer technology in elementary schools*. (Doctoral Dissertation, St. John's University, 2000). *Dissertation Abstracts International, 61*, 1746.

Scheffler, F. L., & Logan, J. P. (1999). Computer technology in schools: What teachers should know and be able to do. *Journal of Research on Computing in Education, 31*(1) 305-346.

Schmidt, R., McGee, S., Scott, L., Kirby, J., Norris, K., & Blaney, L. S. (2002). *Promoting constructivist uses of technology through professional development*. Paper presented at the American Educational Research Association, New Orleans.

Schrum, L. (1999). Technology professional development for teachers. *Educational Technology Research and Development, 47*(4), 83-90.

Scott, T., Cole, M., & Engel, M. (1992). Computer in education: A cultural constructivist perspective. *Review of Research in Education, 18*, 191-251.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Grounded theory procedures and techniques* (2nd ed.). Thousand Oaks, CA: Sage.

Stuart, C., & Thurlow, D. (2000). Making it their own: Preservice teachers' experiences, beliefs, and classroom practices. *Journal of Teacher Education, 51*(2), 113-121.

Swan, K., & Mitrani, M. (1993). The changing nature of teaching and learning in the computer-based classroom. *Journal of Research on Computing in Education, 26*(1), 40-54.

Tashakkori, A., & Teddlie, C. (1998) *Mixed methodology: Combining qualitative and quantitative approaches*. Thousand Oaks, CA: Sage.

Trend, D. (200). *Welcome to Cyberschool: Education at the crossroads in the information age*. Lanham, MD: Roman & Littlefield Publishers.

U.S. Congress, Office of Technology Assessment. (1995). *Teachers and technology*: *Making the connection* (OTA-HER-616). Washington, DC: U.S. Government Printing Office.

Van Manen, M. (1990). *Researching lived experience: Human science for an action sensitive pedagogy*. Albany, NY: State University of New York.

Vannatta, R. A., & Beyerbach, B. (2000). Facilitating a constructivist vision of technology integration among education faculty and preservice teachers. *Journal of Research on Computing in Education, 33*(2), 132-148.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1986). *Thought and language*. Cambridge, MA: MIT.

Weglinsky, H. (1998). Does it compute? The relationship between educational technology and student achievement in mathematics. *Educational Testing Service Policy Information Center.*

Windschitl, M., & Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. *American Educational Research Journal, 39*(1), 165-205).

Woodrow, J., Mayer-Smith, J., & Pedretti, E. (2000). Assessing technology enhanced instruction: A case study in secondary science. *Journal of Educational Computing Research, 23*(1), 15-39.

APPENDIX A: Sample Email to District Superintendent

Dear Mr./Ms./Dr.:

I am a doctoral student at Penn State University working on my dissertation research involving technology integration. I am interested in interviewing and observing exemplary technology-using teachers to explore their beliefs and attitudes. Ultimately, the findings of this research could result in the design of better professional development for more effective technology integration practices.

I would like to have permission to contact principals and technology coordinators who could identify exemplary technology-using teachers in their respective schools. Identified teachers' participation would be strictly voluntary.

The results of the study would be provided to your school district.

If you have any questions, or would like to meet to discuss this further, please let me know either by phone (814-466-3301) or email (pmb6@psu.edu).

Thank you.

Paula Bigatel

APPENDIX B: Sample Email to Principal/Technology Coordinator

Dear Mr./Ms./Dr.:

I am a doctoral student at Penn State University working on my dissertation research involving technology integration. I am interested in interviewing and observing exemplary technology-using teachers to explore their beliefs and attitudes. Mr./Ms./Dr./ XXX, has given me permission to conduct my study in your school district and to contact you and the exemplary technology-using teachers you identify for possible participation.

My request is that you identify the exemplary technology-using teachers that I may contact. I will not be able to interview and observe all of them, but would like to contact the ones you suggest, then, select from those you identify to participate in this study. The teachers' participation is voluntary. The results of this research would be reported to you upon the completion of the study. The findings of this study could result in the design of better professional development for more effective technology integration practices.

Would it be possible to set up a time to meet with you at your convenience to review my study in more detail? You may contact me by phone at (814) 466-3301 or email at pmb6@psu.edu.

Thank you,

Paula Bigatel

APPENDIX C: Sample Email to Exemplary Technology-Using Teacher

Dear Mr./Ms./Dr.:

I am a doctoral student at Penn State University working on my dissertation research involving technology integration. My study is about the beliefs and attitudes of exemplary technology-using teachers. Mr./Ms./Dr./ XXX, has given me permission to conduct my study in your school district and to contact you. Mr./Ms./Dr., your principal/technology coordinator, has identified you as an exemplary technology-using teacher. I would be interested in setting up a time to meet with you to talk about my study. The study involves interviewing and observing you in the classroom. Your participation, however, is strictly voluntary.

Interviews and observations will take approximately one hour each. I would also like to have permission to contact you by email or telephone if I have additional questions.

The results of this research would be reported to the school district upon the completion of the study. Your data will be kept confidential and in the report, there will be no identifying references to you. The findings of this study could result in the design of better professional development for more effective technology integration practices.

If you have any questions, you may contact me by phone at (814) 466-3301 or email at pmb6@psu.edu. I would greatly appreciate your contribution.

Thank you,

Paula Bigatel

Letter to teachers identified and pre-screened but not asked to participate:

Dear. Mr./Ms./Dr.:

I appreciated the time you were able to spend with me concerning my study on the beliefs and attitudes of exemplary technology-using teachers. I have had to reduce the number of participants for this study in order to make it more manageable. I received over XXX number of referrals of exemplary technology-using teachers and could only accept 10-12 participants.

Therefore, I could not include you in my study at this time. Thank you for your interest.

If you have any questions regarding my study, please contact me by phone at 814-466-3301, or email me at pmb6@psu.edu.

Thank you.

Sincerely,

Paula Bigatel
Penn State University

APPENDIX D: Teachers' Demographic Variables

1. Age: 20-29 _____ 30-39 _____ 40-49 _____ 50-59 _____ over 60 _____
2. Gender: Male _____ Female _____
3. Total Number of Years Teaching: _____
4. Current Grade You Teach: _____
5. Subject/Content _____
6. Educational Level _____
7. How often have you participated in self-directed training in the last 3 years? _____
    a. What type of training? _____
    b. What duration? _____
8. How many hours per week do you use a computer at home? _____

APPENDIX E: Interview Protocol

Date: _____

Time: _____

Location: _____

Research Question #1: What are the beliefs and attitudes of exemplary technology-using teachers with respect to a) the teaching and learning process, b) the value of technology in education?

1. Can you describe yourself as a teacher (teacher identity)?
2. What is your definition of beliefs? Attitudes?
3. What are your beliefs about how learners learn?
4. How do you feel about change/innovations?

Research Question #2: What has influenced the development of the beliefs and attitudes of exemplary technology-using teachers?

2. Describe your early learning experiences.
3. Describe your teacher education experience.
4. Who was (were) your most memorable teacher(s) and explain why?
5. Describe your present learning context.
6. Do you recall, when it was as a teacher or student that you began to see relationships between teaching, learning and technology?

Research Question #3: How have exemplary technology-using teachers' beliefs and attitudes affected their instructional practices?

1. What are your feelings about the role of technology in education?
2. How do your beliefs about teaching and learning influence your use of technology in the classroom? And vice versa?
3. How has your teaching changed with respect to technology? For example, can you describe a typical lesson you would teach with technology – and one you might teacher without technology to illustrate the difference?
4. Why do you think someone might identify you as an exemplary technology-using teacher?
5. Would you invite me to a technology-based lesson that you feel would impress me as exemplary?

APPENDIX F: Informed Consent Form

Informed Consent Form for Social Science Research
The Pennsylvania State University

ORP USE ONLY:
The Pennsylvania State University
Office for Research Protections

Approval Date: 6/9/03 – J. Mathie

Expiration Date: 6/8/04 – J. Math

Social Science Institutional Revie

Title of Project: Exploring the Beliefs and Attitudes of Exemplary Technology-Using Teachers

Principal Investigator: Paula M. Bigatel

Advisor: Dr. Barbara Grabowski

1. Purpose of the Study: The purpose of this study is to examine the beliefs and attitudes of exemplary technology-using teachers. This study will describe these beliefs and attitudes and explain the process of how they were formed and how they influence instructional practice.

2. Procedures to be followed: Your participation in this study will consist of an interview and observation. Documents such as lesson plans and student work (with their names removed) may be examined. Interviews will last no more than one hour with a possibility of follow-up interviews with your permission. Follow-up interviews will last no more than 20 minutes. Interviews will be recorded and tapes will be stored in a locked cabinet at Penn State University – 314 Keller Bldg. Paula Bigatel will have access to these tapes. Tapes will be destroyed five years after the study is completed. Observations will last no more than one hour. Duration of the study will be from May to September 1.

3. Discomforts and Risks: There are no risks in participating in this research beyond those experienced in everyday life. Some of the questions may be perceived as personal and cause some annoyance. You need not answer any question that makes you feel uncomfortable.

4. Benefits:
   a. You might learn more about yourself by participating in this study. You might become more conscious of how your beliefs and attitudes influence your instructional practices.
   b. The findings of this study could be used to design professional development that could help other teachers integrate technology more effectively into their practices.

5. Statement of Confidentiality: Only the person in charge will know your identity. If this research is published, no information that would identify you will be written.

6. Right to Ask Questions: You can ask questions about the research. The person in charge will answer your questions. Contact Paula Bigatel at 814-466-3301 with questions. If you have questions about your rights as a research participant, contact Penn State's Office for Research Protections at (814) 865-1775.

7. Compensation: There is no compensation for participating in this study.

8. Voluntary Participation: You do not have to participate in this research. You can end your participation at any time by telling the person in charge. You do not have to answer any questions you do not want to answer.

You must be 18 years of age or older to consent to participate in this research study. If you consent to participate in this research study and to the terms above, please sign your name and indicate the date below.

You will be given a copy of this consent form to keep for your records.

_____ _____

Participant Signature Date

The informed consent procedure has been followed.

_____ _____

Investigator Signature Date

APPENDIX G: Classroom Observation Protocol

Classroom Information

Date: Time:	Subject taught:
Classroom:	Grade level:

Physical Description of Classroom

Size: Number of students: Seating Arrangement	Description:

Technological Support/Teaching Support

Equipment: Assistance:

Classroom Activities

Describe the activities going on in this classroom. List the activities, record how long the activities lasted, and describe who is participating, and students' actions.

Lesson Activities	Length of Time	Who is Participating	Student Actions

APPENDIX H: Classroom Variables of Engaged Learning

The classroom variables indicating effective teaching and learning are:

- children are engaged in authentic and multidisciplinary tasks
- assessments are based on students' performance of real tasks
- students participate in interactive modes of instruction
- students work collaboratively
- students are grouped heterogeneously
- the teacher is a facilitator in learning
- students learn through exploration

Source: Barbara Means' *Classroom Variables (*http://archive.ncsa.uiuc.edu/EDU/icm/html/class_var.html

APPENDIX I: Indicators of Engaged Learning

1. Indicator: ***Vision of Engaged Learning***

What does engaged learning look like? Successful, engaged learners are responsible for their own learning. These students are self-regulated and able to define their own learning goals and evaluate their own achievement. They are also energized by their learning; their joy of learning leads to a lifelong passion for solving problems, understanding, and taking the next step in their thinking. These learners are strategic in that they know how to learn and are able to transfer knowledge to solve problems creatively. Engaged learning also involves being collaborative--that is, valuing and having the skills to work with others.

2. Indicator: ***Tasks for Engaged Learning***

In order to have engaged learning, tasks need to be challenging, authentic, and multidisciplinary. Such tasks are typically complex and involve sustained amounts of time. They are authentic in that they correspond to the tasks in the home and workplaces of today and tomorrow. Collaboration around authentic tasks often takes place with peers and mentors within school as well as with family members and others in the real world outside of school. These tasks often require integrated instruction that incorporates problem-based learning and curriculum by project.

3. Indicator: ***Assessment of Engaged Learning***

Assessment of engaged learning involves presenting students with an authentic task, project, or investigation, and then observing, interviewing, and examining their presentations and artifacts to assess what they actually know and can do. This assessment, often called performance-based assessment, is generative in that it involves students in generating their own performance criteria and playing a key role in the overall design, evaluation, and reporting of their assessment. The best performance-based assessment has a seamless connection to curriculum and instruction so that it is ongoing. Assessment should represent all meaningful aspects of performance and should have equitable standards that apply to all students.

4. Indicator: ***Instructional Models and Strategies for Engaged Learning***

The most powerful models of instruction are interactive. Instruction actively engages the learner, and is generative. Instruction encourages the learner to construct and produce knowledge in meaningful ways. Students teach others interactively and interact generatively with their teacher and peers. This allows for co-construction of knowledge, which promotes engaged learning that is problem-, project-, and goal-based. Some common strategies included in engaged learning models of instruction are individual and group summarizing, means of exploring multiple perspectives, techniques for building upon prior knowledge, brainstorming, Socratic dialogue, problem-solving processes, and team teaching.

APPENDIX I (Cont'd)

5. Indicator: ***Learning Context of Engaged Learning***
For engaged learning to happen, the classroom must be conceived of as a knowledge-building learning community. Such communities not only develop shared understandings collaboratively but also create empathetic learning environments that value diversity and multiple perspectives. These communities search for strategies to build on the strengths of all of its members. Truly collaborative classrooms, schools, and communities encourage students to ask hard questions, define problems, lead conversations, set goals, have work-related conversations with family members and other adults in and out of school, and engage in entrepreneurial activities.

6. Indicator: ***Grouping for Engaged Learning***
Collaborative work that is learning-centered often involves small groups or teams of two or more students within a classroom or across classroom boundaries. Heterogeneous groups (including different sexes, cultures, abilities, ages, and socioeconomic backgrounds) offer a wealth of background knowledge and perspectives to different tasks. Flexible grouping, which allows teachers to reconfigure small groups according to the purposes of instruction and incorporates frequent heterogeneous groups, is one of the most equitable means of grouping and ensuring increased learning opportunities.

7. Indicator: ***Teacher Roles for Engaged Learning***
The role of the teacher in the classroom has shifted from the primary role of information giver to that of facilitator, guide, and learner. As a facilitator, the teacher provides the rich environments and learning experiences needed for collaborative study. The teacher also is required to act as a guide--a role that incorporates mediation, modeling, and coaching. Often the teacher also is a co-learner and co-investigator with the students.

8. Indicator: ***Student Roles for Engaged Learning***
One important student role is that of explorer. Interaction with the physical world and with other people allows students to discover concepts and apply skills. Students are then encouraged to reflect upon their discoveries, which is essential for the student as a cognitive apprentice. Apprenticeship takes place when students observe and apply the thinking processes used by practitioners. Students also become teachers themselves by integrating what they've learned. Hence, they become producers of knowledge, capable of making significant contributions to the world's knowledge.

Source: Jones, B., Valdez, G., Nowakowski, J., & Rasmussen, C. (1994). *Designing Learning and Technology for Educational Reform*. Oak Brook, IL: North Central Regional Educational Laboratory.

APPENDIX J: National Educational Technology Standards for Teachers

All classroom teachers should be prepared to meet the following standards and performance indicators.

II. PLANNING AND DESIGNING LEARNING ENVIRONMENTS AND EXPERIENCES

Teachers plan and design effective learning environments and experiences supported by technology. Teachers:

A. Design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.
B. Apply current research on teaching and learning with technology when planning learning environments and experiences.
C. Identify and locate technology resources and evaluate them for accuracy and suitability.
D. Plan for the management of technology resources within the context of learning activities.
E. Plan strategies to manage student learning in a technology-enhanced environment.

III. TEACHING, LEARNING, AND THE CURRICULUM

Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning. Teachers:

A. Facilitate technology-enhanced experiences that address content standards and student technology standards.
B. Use technology to support learner-centered strategies that address the diverse needs of students.
C. Apply technology to develop students' higher-order skills and creativity.
D. Manage student-learning activities in a technology-enhanced environment.

Source: NETS for Teachers - Preparing Teachers to Use Technology (2002, p. 306)

APPENDIX K: Document Analysis Protocol

Identifying Information

Who Created:	
Date Created:	
Location:	
Description of Document:	

Purpose of Document

Significance of Document

APPENDIX L: Learner-Centered Psychological Principles

METACOGNITIVE AND COGNITIVE FACTORS		
Principle 1	The nature of the learning process	Learning is a natural process of pursuing personally meaningful goals. It is active, volitional, and internally motivated; it is a process of discovering and constructing meaning from information and experience, filtered through the learner's unique perception, thoughts, and feelings.
Principle 2	Goals of the learning process	The learner seeks to create meaningful, coherent representations of knowledge regardless of the quantity and quality of the data available.
Principle 3	Construction of knowledge	The learner links new information with existing and future-oriented knowledge in uniquely meaningful ways.
AFFECTIVE FACTORS		
Principle 4	Higher-order thinking	Higher-order strategies for "thinking about thinking" – for overseeing and monitoring mental operations- facilitate creative and critical thinking and the development of expertise.
Principle 5	Motivational influences on learning	The depth and breadth of information processed, and what and how much is learned and remembers, are influenced by (a) self-awareness and beliefs about personal control, competence, and ability; (b) clarity and saliency of personal values, interests, and goals; (c) personal expectations for success and failure; (d) affect, emotion, and general states of mind; and (e) the resulting motivation to learn.
Principle 6	Intrinsic motivation to learn	Individuals are naturally curious and enjoy learning, but intense negative cognitions and emotions thwart this enthusiasm.
Principle 7	Characteristics of motivation-enhancing learning tasks	Curiosity, creativity, and higher-order thinking are stimulated by relevant, authentic learning tasks of optimal difficulty and novelty for each student.

APPENDIX L (Cont'd)

DEVELOPMENTAL FACTORS Principle 8	Developmental constraints and opportunities	Individuals' progress through stages of physical, intellectual, emotional, and social development are a function of unique genetic and environmental factors.
PERSONAL AND SOCIAL FACTORS Principle 9	Social and cultural diversity	Learning is facilitated by social interactions and communication with others in flexible, diverse, and adaptive instructional settings.
Principle 10	Social acceptance, self-esteem, and learning	Learning and self-esteem are heightened when individuals are in respected and caring relationships with others, who see their potential, appreciate their unique talents, and accept them as individuals.
INDIVIDUAL DIFFERENCES Principle 11	Individual differences in learning	Learners have different capabilities and preferences for learning modes and strategies.
Principle 12	Cognitive filters	Personal beliefs, thoughts, and understandings resulting from prior learning and interpretations become the individual's basis for constructing reality and interpreting life experiences.

Source: *American Psychological Association and the Mid-continent Regional Educational Laboratory,* Washington, DC (1993).

Paula M. Bigatel

Education

Ph.D., Instructional Systems - The Pennsylvania State University - May, 2004
M.Ed., Instructional Systems - The Pennsylvania State University - December, 2000
Teaching as a Second Language Certificate (TESL) - Concordia University - May, 1977
Bachelor of Arts, Psychology - Concordia University - May, 1974

Employment

5/03 – Present Schreyer Institute for Teaching Excellence, Rider II Bldg., State College, PA
Wage Payroll (5/03 – 8/03, *Graduate Assistant* (8/03 – present)
Support programs for teaching and learning, teach course in college teaching

8/03 – Present - Penn State University, Continuing Education, *Instructor*
Insys 441 Web Design, Insys 447Multimedia, Insys 448 Internet in Classroom

8/01 – 8/03 Penn State University, Instructional Systems, University Park, PA
Graduate Assistant, *Instructor,* Insys 400 (Technology in Education)

3/97 - 2/01 Penn State University, Office of Pre-Service Teaching, College of Education, *Staff Assistant*

3/93 - 3/97 Johnson's Home Furnishings, Inc. Bellefonte, PA, *Office Manager*

4/91 - 3/93 Preferred Temps, State College, PA, *Placement Consultant*

2/87 - 4/91 Brokers Mortgage Placement, State College, PA, *Broker/Owner*

2/83 - 2/87 Zimmerman Homes, Inc. State College, PA, *Office Manager*

8/81 - 10/82 Professional Temporary Services, Santa Clara, CA, *Branch Manager*

8/78 - 8/81 Staff Builders, Santa Clara, CA, *Branch Manager*

6/73 - 5/78 Department of Defense, St. Jean, Quebec, Canada, *Language Teacher (ESL)*

Professional Affiliations

Association for Supervision and Curriculum Development (ASCD)
Association for Educational Communications and Technology (AECT),
Pennsylvania Association for Educational Communications and Technology (PAECT)
International Society for Technology in Education (ISTE)
Phi Delta Kappa (PDK), Treasurer
Nittany Valley Medical Center, IRB Board Member